55-1510-216-10

TM 55-1510-216-10

TECHNICAL MANUAL

OPERATOR'S MANUAL

ARMY MODELS U-3A AND U-3B AIRCRAFT

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

11 DECEMBER 1978

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CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 5 April 1982

Operator's Manual

ARMY MODELS U-3A AND U-3B AIRCRAFT

TM 55-1510-216-10, 11 December 1978, is changed as follows:

1. Remove and insert pages as indicated below.

	Remove Pages	Insert Pages
Warning	a and b	a and b
Section II	2-13 thru 2-16	2-13 thru 2-16
Section III	3-3 and 3-4	3-3 and 3-4
Section V	5-1 and 5-2	5-1 and 5-2
Section VII	7-2A/7-2B	7-2A and 7-2B

2. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

3. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, Operator Maintenance Requirements for U-3A/B aircraft.

TM 55-1510-216-10
C 1

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 3 July 1980

Operator's Manual

ARMY MODELS U-3A AND U-3B AIRCRAFT

TM 55-1510-216-10, 11 December 1978, is changed as follows:

1. Remove and insert pages as indicated below.

	Remove pages	Insert pages
Chapter 3	3-3 thru 3-6	3-3 thru 3-6A/3-6B
Chapter 7	7-2A/7-2B	7-2A/7-2B
Chapter 9	9-3 and 9-4	9-3 and 9-4

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WARNING

DEFINITIONS

Warnings, cautions, and notes shall be used to emphasize important and critical instructions and shall be used for the following conditions:

WARNING

An operating procedure, practice, etc., that, if not correctly followed, will result in personnel injury or loss of life.

CAUTION

An operating procedure, practice, etc., that, if not strictly observed, will result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., that is essential to highlight.

NOTE

Personnel performing operations, procedures, and practice that are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury, death, or an aborted mission.

STARTING ENGINES

Coordinate all cockpit actions with ground observer. Insure that brakes are set and the aircraft is properly chocked, prop and blast area is clear, and fire guard is posted.

GROUND OPERATION

Engines shall be started and the aircraft operated only by authorized personnel. Reference AR 95-1.

FIRE EXTINGUISHER

Exposure to high concentrations of Bromotrifluoromethane (CF_3Br) extinguishing agent or decomposition products shall be avoided. The liquid shall not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burns.

VERTIGO

The rotating beacon light shall be turned off during flight through clouds to prevent sensations of vertigo as a result of reflections of the light on the clouds.

CARBON MONOXIDE

When smoke or suspected carbon monoxide fumes exist, the crew shall immediately set the diluter control lever to 100% OXYGEN on their individual oxygen regulator panel, don masks, and activate the system. If symptoms of hypoxia exist, move the emergency pressure control lever to EMERGENCY.

HANDLING FUEL AND OIL

Turbine fuels and lubricating oils contain additives that are poisonous and readily absorbed through the skin. Do not allow them to remain on the skin longer than necessary.

ACIDS

Battery electrolyte is harmful to the skin and clothing. Neutralize any spilled electrolyte by flushing contacted areas thoroughly with water.

NOISE LEVELS

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices, such as the aviator helmet or ear plugs are required to be worn by all personnel in and around the aircraft during its operation.

TECHNICAL MANUAL

TM55-1510-216-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D C, 11 December 1978

Operator's Manual
ARMY MODELS U-3A AND U-3B AIRCRAFT

REPORTING OF ERRORS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual, direct to: Commander, U. S. Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MTPS, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

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Scope. This manual contains the necessary information for safe and efficient operation of the U-3A and U-3B aircraft. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and, therefore, basic flight principles are avoided. This manual provides the best possible operating instructions under most circumstances; however, multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

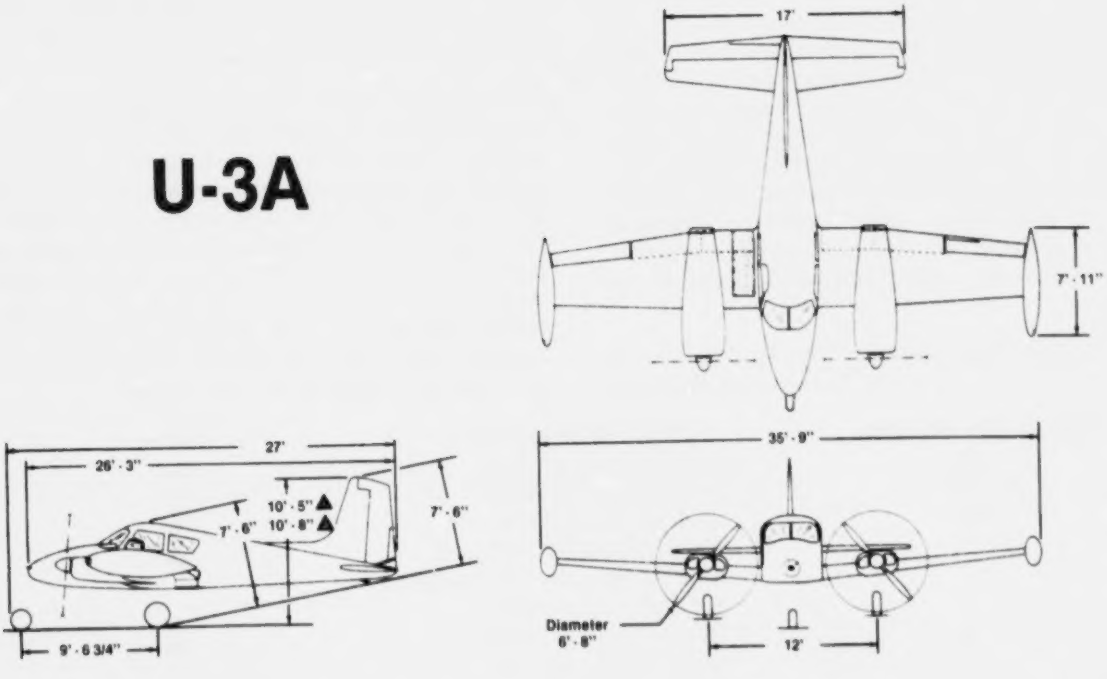
Permissible Operations. The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein.

Serialization Code. The information contained in this Manual is applicable to all U-3A and U-3B aircraft. Code symbols are used, except in sections II and III, to distinguish information related to one group of aircraft from that which is applicable to the other groups of aircraft. When code symbols appear by a paragraph or illustration, the information applies only to that group of aircraft represented by the code symbols. Where no code symbols appear in a paragraph or illustration, the information is applicable to all aircraft.

AIRCRAFT MODEL	USAF SERIAL NO.	CODE
U-3A	57-5846 thru 57-5925	▲1
U-3A	58-2107 thru 58-2186	▲2
U-3B	60-6047 thru 60-6081	▲3
U-3A	57-5846 thru 57-5925 and 58-2107 thru 58-2186 modified per T. O. 1U-3A-519	▲4
U-3A	57-5846 thru 57-5925 58-2107 thru 58-2186 when modified per T. O. 1U-3A-526	▲5

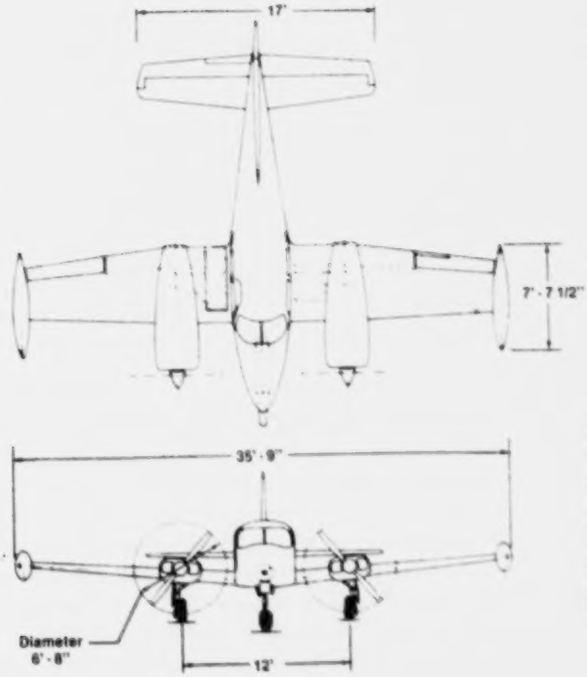
THE AIRCRAFT

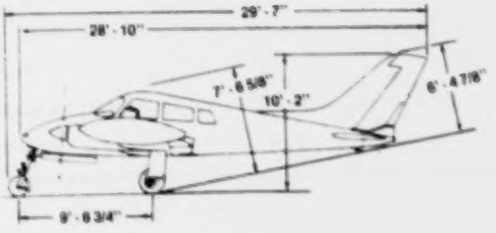
U-3A



THE AIRCRAFT

U-3B





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DESCRIPTION

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THE AIRCRAFT.

The U-3A, and U-3B, designed and manufactured by Cessna Aircraft Company, are five-place, all-metal, low-wing, twin-engine monoplanes. The basic mission of the aircraft is personnel transportation but they can be used for transportation of light cargo in addition to other liaison missions. Distinguishable features of the aircraft are the centerline mounted wing-tip tanks, flat engine nacelles and fully retractable landing gear. Although dual controls are provided, the aircraft can be safely and efficiently flown by one pilot from the left pilot seat in VFR conditions.

MAIN DIFFERENCES TABLE.

The main differences between the U-3A aircraft and the U-3B aircraft are shown in figure 1-1.

MAIN DIFFERENCES TABLE

ITEM	U-3A	U-3B
ENGINES	MODEL 0-470-M 240 HP at 2600 RPM	MODEL I0-470-D 260 HP at 2625 RPM
WING DE-ICING	NO*	YES
PROPELLER ANTI-ICE	NO*	YES
SWEPT VERTICAL STABILIZER AND RUDDER	NO	YES
GROSSWEIGHT	4830	4990
THIRD WINDOW	NO	YES

** Except Aircraft Modified Per T. O. 1U-3A-519*

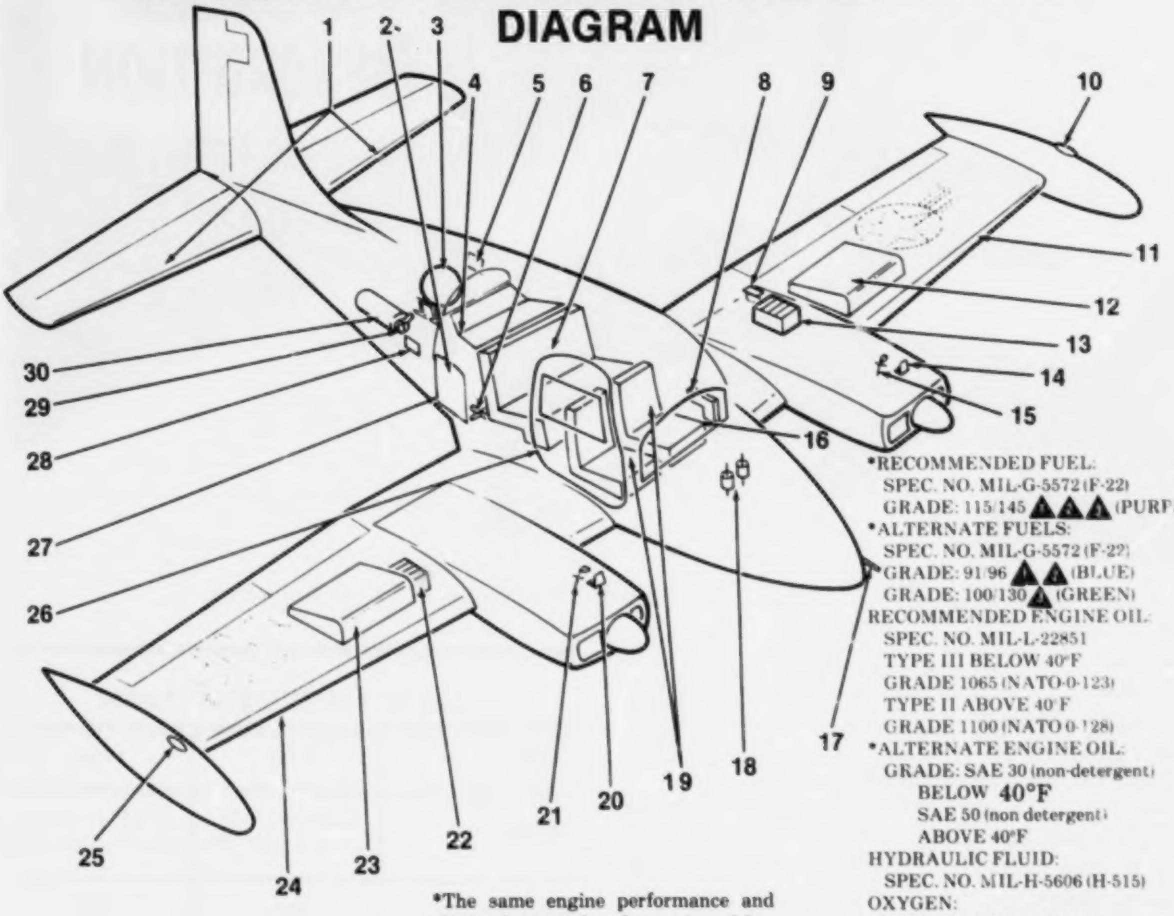
Figure 1-1

DIMENSIONS.

The overall dimensions of the aircraft are as follows:

Wing span .... 35′9″

GENERAL ARRANGEMENT AND SERVICING DIAGRAM



*RECOMMENDED FUEL:
SPEC. NO. MIL-G-5572 (F-22)
GRADE: 115/145 ▲1 ▲2 ▲3 (PURPLE)
*ALTERNATE FUELS:
SPEC. NO. MIL-G-5572 (F-22)
**GRADE: 91/96 ▲1 ▲2 (BLUE)
GRADE: 100/130 ▲3 (GREEN)
RECOMMENDED ENGINE OIL:
SPEC. NO. MIL-L-22851
TYPE III BELOW 40°F
GRADE 1065 (NATO-0-123)
TYPE II ABOVE 40°F
GRADE 1100 (NATO 0-128)
*ALTERNATE ENGINE OIL:
GRADE: SAE 30 (non-detergent)
BELOW 40°F
SAE 50 (non detergent)
ABOVE 40°F
HYDRAULIC FLUID:
SPEC. NO. MIL-H-5606 (H-515)
OXYGEN:
SPEC. NO. MIL-O-27210
ANTI-ICE FLUID: ▲3 ▲4
SPEC. NO. MIL-F-5566
TIRE PRESSURE:
MAIN TIRES: 40 PSI
NOSE TIRES: 30 PSI

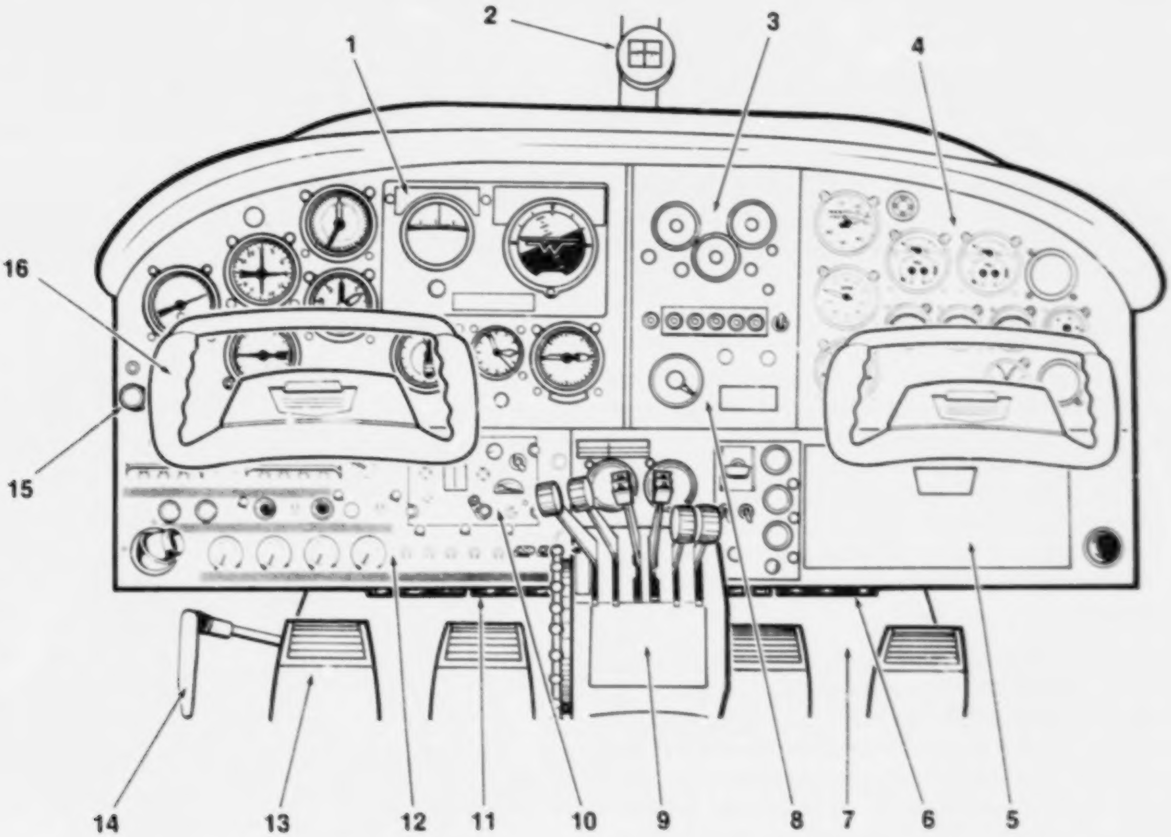
*The same engine performance and limitations apply when using either the recommended or alternate grade fuels.

**Alternate oil should be used only when recommended oil is unavailable.

1. Horizontal Stabilizer De-icing Boot ▲3 ▲4
2. Baggage Compartment
3. De-icing Air Reservoir ▲3 ▲4
4. Utility Shelf
5. De-icing External Filler Door ▲3 ▲4
6. Tow Bar
7. Passenger Seat
8. Circuit Breaker Panel
9. External Power Receptacle
10. Left Tip Tank (main) Fuel Filler Cover
11. Left Wing De-icing Boot ▲3 ▲4
12. Left Auxiliary Tank Fuel Filler Door
13. Batteries
14. Left Engine Oil Filler Door
15. Left Engine Oil Dipstick
16. Instrument Panel
17. Pitot Tube
18. Master Brake Cylinders
19. Pilot and Copilot Seats
20. Right Engine Oil Filler Door
21. Right Engine Oil Dipstick
22. Anti-ice Fluid Reservoir ▲3 ▲4
23. Right Auxiliary Tank Fuel Filler Door
24. Right Wing De-icing Boot
25. Right Tip Tank (main) Fuel Filler Cover
26. Cabin Door
27. Baggage Compartment Door
28. Oxygen External Filler Door
29. Oxygen Shut-off Valve
30. Oxygen Cylinder

Figure 1-2

TYPICAL CABIN FORWARD VIEW



1. Flight Instrument Group
2. Magnetic Compass
3. VHF Navigation Control Panel
4. Engine Instrument Group
5. Right Switch and Control Panel
6. Copilot's Heat Register▲▲
7. Front Cabin Heat Direct Outlet▲
8. VHF Communication Control Panel
9. Engine Control Pedestal
10. LF Navigation Control Panel
11. Pilot's Heat Register▲▲
12. Left Switch and Control Panel
13. Rudder Pedal
14. Parking Brake Handle
15. Cigarette Lighter
16. Control Wheel

Figure 1-3

Length............................▲1 ▲2 27'0"
▲3 29'7"
Height.............................▲1 10'5"
▲2 10'8"
▲3 10'2"

Refer to Section II (figure 2-2) for turning radius and ground clearance.

GROSS WEIGHT.

The design gross weight of the aircraft is as follows:
Aircraft......................▲1 ▲2 4830 Pounds
Aircraft........................▲3 4990 Pounds
Refer to Section V for additional weight information.

ENGINES ▲1 ▲2

Two horizontally-opposed, six-cylinder, Continental Model O-470-M engines, rated at 240 horsepower at 2600 rpm, power the aircraft. The engines utilize wet sump oil systems, pressure-type carburetion, and jet-augmenter exhaust systems. Carburetion is furnished by down-draft, single barrel, pressure-injection type carburetors incorporating manually-operated mixture control valves.

ENGINES ▲3

Two horizontally-opposed, six-cylinder, Continental Model IO-470-D engines, rated at 260 horsepower at 2625 rpm, power the aircraft. The engines utilize wet sump oil system, continuous-flow fuel injection, and jet-augmenter exhaust systems including mufflers. Fuel injection is provided by a multi-nozzle, continuous flow type fuel injection system, which controls fuel flow to match engine air flow. Manual mixture controls and a fuel flow gauge, indicating fuel flow rate, are provided for precise leaning at any combination of altitude and power setting.

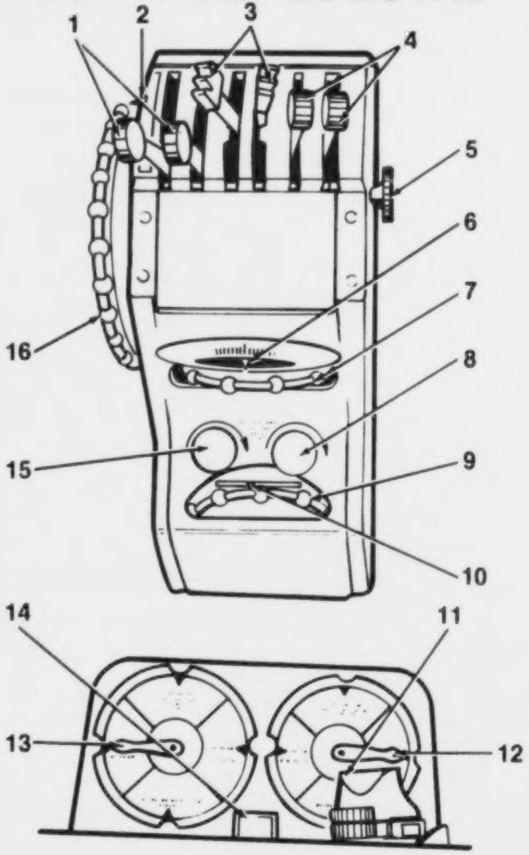
THROTTLES.

Engine power is controlled by the throttles (1, figure 1-4) which are the two levers on the top of the engine control pedestal nearest the pilot. They are identified by their round, smooth knobs and are the longest levers on the pedestal. The throttles are operated in a conventional manner (forward position is OPEN; CLOSED is aft). Retarding either throttle to a position corresponding to approximately 12 inches manifold pressure when the landing gear is not down and locked, actuates a micro switch and completes the circuit through a flasher unit to the landing gear warning horn. The landing gear warning horn will then sound intermittently to indicate an unsafe condition for landing.

MIXTURE LEVERS.

The mixture levers (4, figure 1-4) are mounted on the

ENGINE
CONTROL PEDESTAL



1. Throttles
2. Elevator Trim Tab Position Indicator
3. Propeller Levers
4. Mixture Levers
5. Friction Lock Knob
6. Rudder Trim Tab Position Indicator
7. Rudder Trim Tab Control Wheel
8. Right Engine Carburetor Air Knob ▲1 ▲2 Induction Air Handle ▲3
9. Aileron Trim Tab Control Wheel
10. Aileron Trim Tab Position Indicator
11. Microphone
12. Right Fuel Selector Valve Handle
13. Left Fuel Selector Valve Handle
14. Fuel Selector Valve Handle Light
15. Left Engine Carburetor Air Knob ▲1 ▲2 Induction Air Handle ▲3
16. Elevator Trim Tab Control Wheel

Figure 1-4

engine control pedestal and are the two levers nearest the copilot. These levers are distinguished by their sharp-pointed, round knobs. The FULL RICH (FR) position is full forward, full aft is IDLE CUT-OFF (ICO). Manual leaning is accomplished by placing levers between the FULL RICH and IDLE CUT-OFF positions. Refer to Section VII for manual leaning procedure. Numbered index marks are provided between the levers to facilitate mixture lever settings.

FRICTION LOCK KNOB.

A friction lock knob (5, figure 1-4) is located on the right side of the control pedestal. Rotation of the fric-

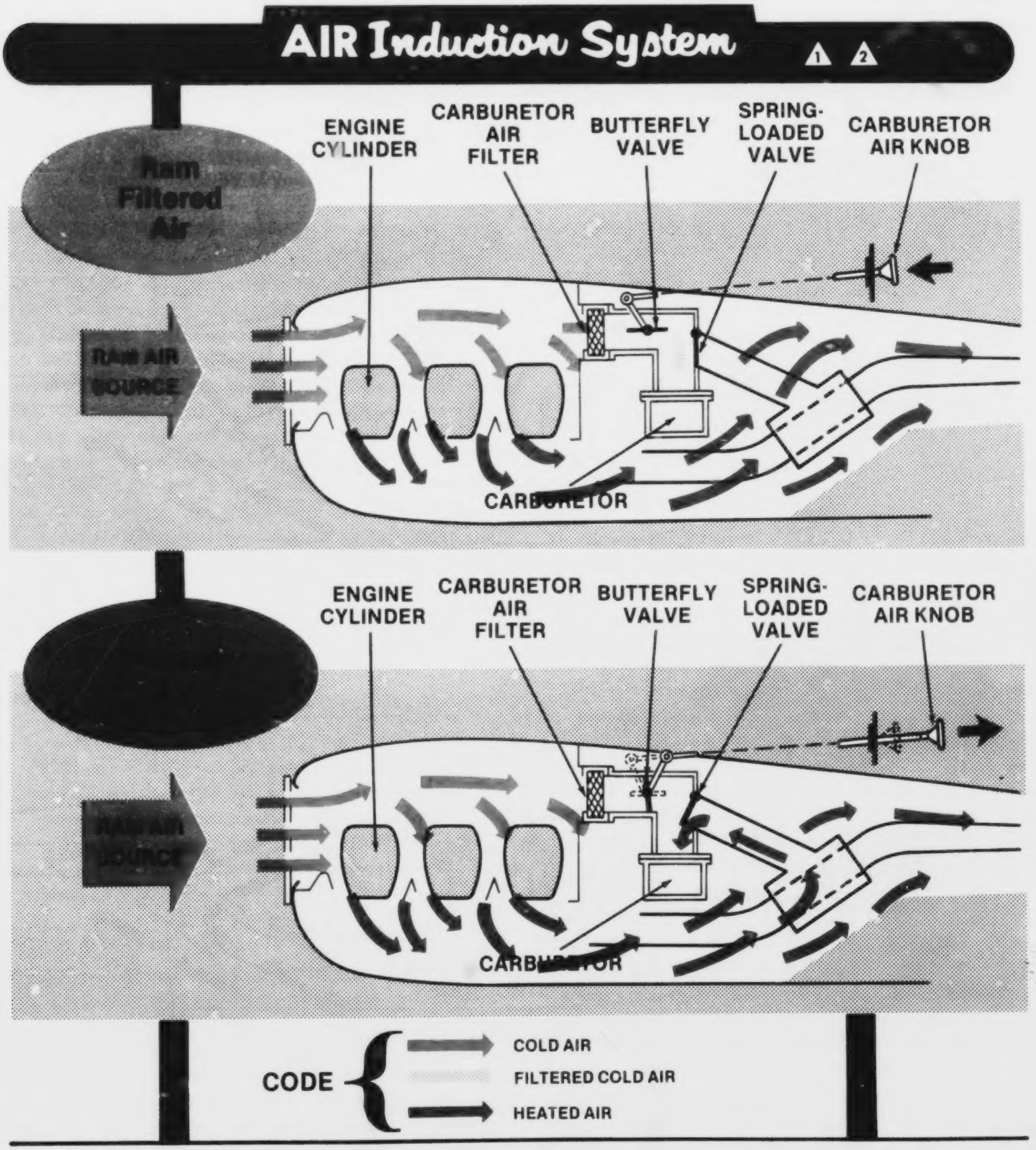


Figure 1-5

tion lock knob clockwise increases the friction and prevents creeping of the throttle, mixture, and propeller levers. Counterclockwise rotation of the knob decreases the friction and permits free movement of the control levers.

CARBURETOR AIR KNOBS. ▲ ▲

Carburetor air knobs (8 and 15, figure 1-4) are located on the engine control pedestal between the aileron and rudder trim tab control wheels. The carburetor air knobs positions are: COLD AIR (in position) and HEAT (full out position). Counterclockwise rotation of the knob unlocks the control and clockwise rotation locks it. The carburetor air knobs provide a heated source of air for unusual conditions under which carburetor or induction manifold ice might form. When

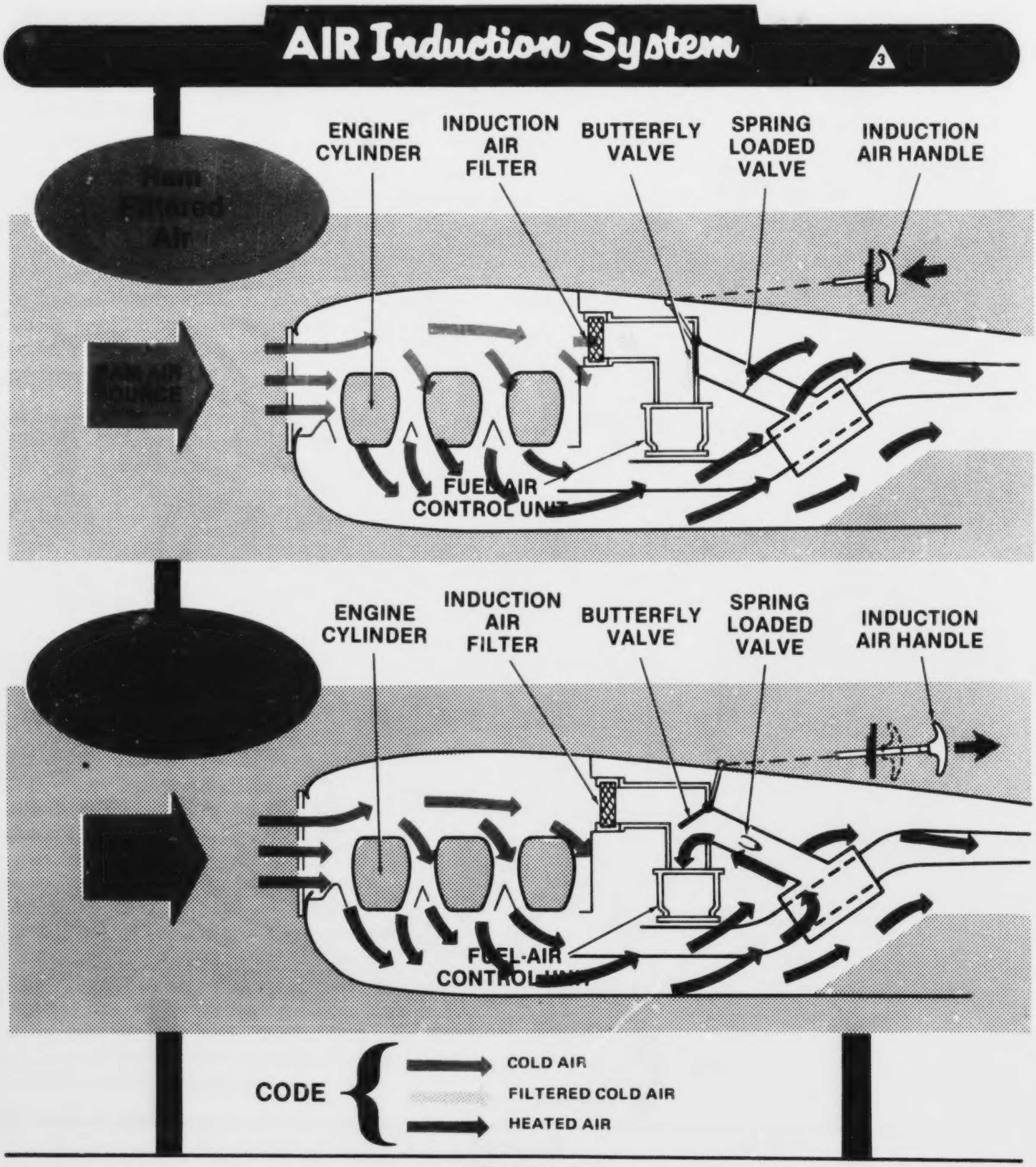


Figure 1—6

the knobs are pulled to the HEAT (full out position), butterfly valves close off the ram-air intake openings to the carburetors. With the valves in these positions, a partial vacuum is created in the carburetor air intake boxes, causing spring-loaded valves to open automatically, thereby admitting heated air to the carburetors (see figure 1-5).

CAUTION

> The carburetor air knobs should be set only in HEAT or COLD AIR positions. Do not use any intermediate positions. Partial carburetor heat application can result in low power at full throttle, erratic air flow through the carburetor and possible rough engine operation due to poor mixture distribution.

INDUCTION AIR HANDLES. ▲

The induction air handles (8 and 15, figure 1-4) are located on the engine control pedestal between the aileron and rudder trim tab control wheels. The induction air handles positions are: COLD AIR (in position) and INDUCTION AIR (full out position). Counterclockwise rotation of the knob unlocks the control and clockwise rotation locks it. The induction air handles provide a heated source of air for unusual conditions under which ice might form in the induction system. When the handles are pulled to the INDUCTION AIR (full out position), butterfly values close off the ram-air intake opening to the fuel-air control unit. With the valves in these positions, a partial vacuum is created in the induction systems causing spring-loaded valves to open automatically, thereby admitting heated air to the induction system (see figure 1-6).

CAUTION

> The induction air handles should be set only in INDUCTION AIR or COLD AIR position. Do not use any intermediate positions. Partial induction air application can result in low power at full throttle, erratic air flow through the fuel-air control unit and possible rough engine operation due to poor mixture distribution.

ENGINE COOLING.

Engine cooling air is admitted at the front of the engine cowling and directed around the cylinders to the jet-augmenters. The high velocity exhaust gases are released into the jet-augmenters, thereby causing a pumping action which pulls cooling air around the cylinders and through all parts of the engine compartment. In this cooling system an increase in power causes a corresponding increase in "pumping action", which in conjunction with the forward speed of the aircraft, increases the flow of cooling air throughout the engine compartment. This design feature eliminates the need for cowl flaps.

IGNITION SYSTEM

Engine ignition is supplied by dual magnetos on each engine. A separate switch controls each magneto. The left magnetos fire the upper spark plugs on the left cylinders on.each engine, and the lower spark plugs on the right cylinders. The right magnetos fire the remaining spark plugs.

Ignition Switches

Four ignition switches (6, 7, 8, and 9, figure 1-7) control the magneto-powered ignition systems. The switches are ON in the up position and OFF in the down position. A bar is mounted above the switches and allows them to be turned off simultaneously. The switches may also be turned off individually to permit the checking of each magneto for condition and operation.

Note

> When the left or right ignition switch for either engine is placed in the OFF position the respective magneto is grounded and the opposite magneto is being checked for condition and operation.

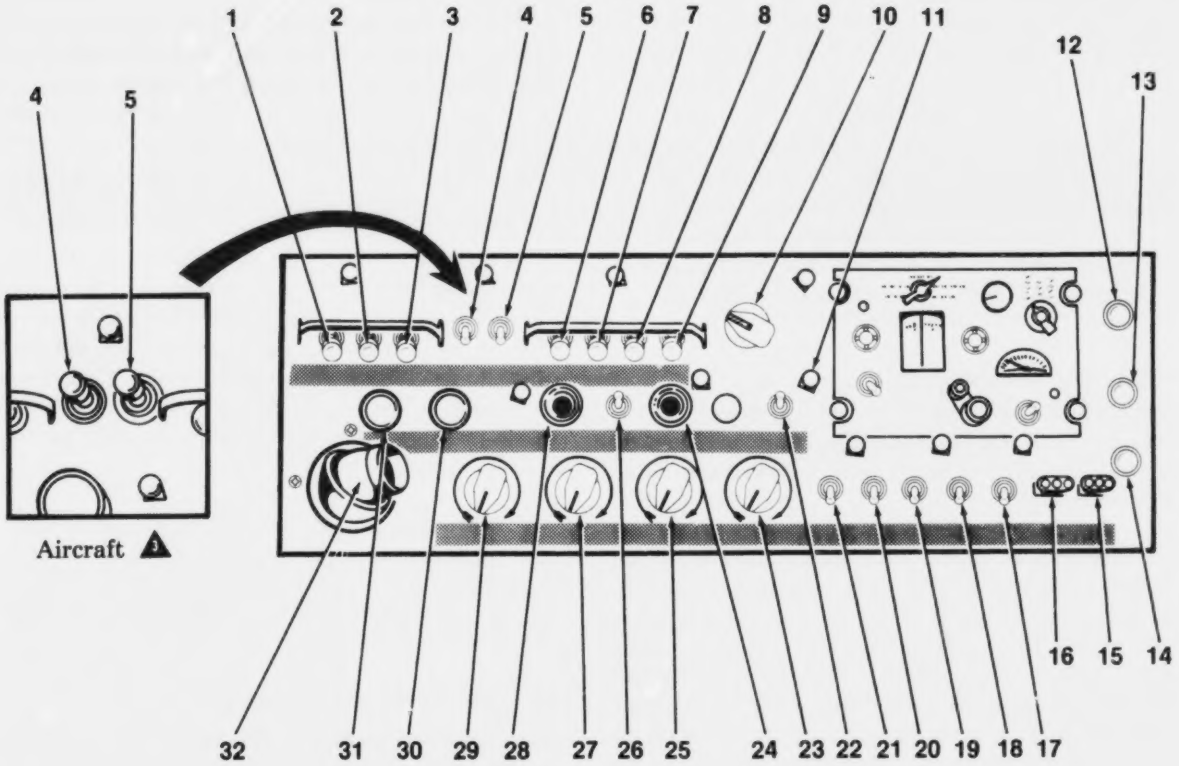
ENGINE PRIMER SWITCH. ▲ ▲

An engine primer switch (26, figure 1-7) is provided on the left switch and control panel between the red-ringed starter buttons. The switch is a three-position, spring-loaded switch, and derives its power from the aircraft electrical power supply system. When held to LEFT-PRIME, it primes the left engine, or to RIGHT-PRIME, it primes the right engine. When the switch is released it automatically springs back to its OFF position. The primer switch activates a solenoid valve which allows fuel to flow from the fuel pressure line into the priming jets located in the cylinder intake chambers. The fuel boost pump switch for the engine being started must be turned ON at all times during primer operation.

STARTER BUTTONS

Two engine starter buttons (24, and 28, figure 1-7) are provided on the left switch and control panel. The buttons are ringed with a red cup to prevent them from being pushed accidentally. When the starter button is being pressed, a solenoid connects the starter to the bus bar. Electrical power for energizing the starter may be supplied by the aircraft battery or an external power source. When starting the engines, the left engine should be started first. The cable from the battery to this engine is shorter and will permit more electrical

LEFT SWITCH AND CONTROL PANELS



1. Left Generator Switch
2. Battery Switch
3. Right Generator Switch
4. Left Fuel Boost Pump Switch
5. Right Fuel Boost Pump Switch
6. Left Ignition Switch, Left Engine
7. Right Ignition Switch, Left Engine
8. Left Ignition Switch, Right Engine
9. Right Ignition Switch, Right Engine
10. Vacuum Indicator Selector Valve Knob
11. Switch and Control Panel Light (Typical)
12. Landing Gear Up Position Indicator Light
13. Landing Gear Switch
14. Landing Gear Down Position Indicator Light
15. Right Landing Light Switch
16. Left Landing Light Switch
17. Taxi Light Switch
18. Navigation Light Switch
19. Rotating Beacon Light Switch
20. Pitot Heat Switch
21. Cabin Heater Switch
22. Oil Dilution Switch
23. Compass Light Rheostat Knob
24. Right Engine Starter Button
25. Switch Panel — Fuel Selector Valve Light Rheostat Knob
26. Engine Primer Switch ▲1 ▲2
27. Engine Instrument Lights Rheostat Knob
28. Left Engine Starter Button
29. Flight Instrument — Radio Control Panel Lights Rheostat Knob
30. De-icing Charge Knob ▲3 ▲4
31. De-icing Cycle Knob ▲3 ▲4
32. Pilot's Air Vent

Figure 1-7

power to be delivered to the starter. After the left engine is running its generator will supply additional power for starting the right engine.

On aircraft ▲3, when the starter button is depressed, the right magneto of the affected engine is cut out, and a boosted spark is supplied to the left magneto (which is also retarded for starting). Consequently, the engine will not run properly until the starter button is released.

DUAL TACHOMETER.

The dual tachometer (13, figure 1-8; 10, figure 1-9), is the center instrument immediately to the right of the VHF navigation and communication control panels. It has two indicating pointers, marked 1 and 2, to identify left and right engine rpm respectively. The tachometer is calibrated in revolutions-per-minute and each increment on the face of the instrument equals 100 rpm. The tachometer is electrically operated and receives its energy from two engine-driven tachometer generators, one located on each engine.

DUAL MANIFOLD PRESSURE GAGE.

The dual manifold pressure gage (1, figure 1-8; 1, figure 1-9) is located above the dual tachometer immediately adjacent to the VHF navigation control panel. The instrument indicates pressure of the fuel-air mixture entering the engine cylinders, and is calibrated in inches of mercury. Two pointers, marked 1 and 2, indicate the pressure for the left and right engine respectively. The gage is a direct reading, pressure instrument.

CYLINDER HEAD TEMPERATURE GAGES. ▲1 ▲2

Two cylinder head temperature gages (10 and 11, figure 1-8) are located side by side on the instrument panel immediately above the copilot's control column. Cylinder head temperature indications are controlled by electrical resistance type temperature bulbs which receive their energy from the aircraft electrical power supply system. The electrical circuit is protected, by a push-to-reset type circuit breaker located on the circuit breaker panel. One temperature bulb is located under the left, center cylinder (number 4) on each engine. The cylinder head temperature gages are calibrated in degrees Fahrenheit.

ENGINE COMBINATION GAGE UNITS. ▲1 ▲2

Two engine combination gage units (3 and 4, figure 1-8) are provided, one for each engine, and are located in the upper right side of the instrument panel. Each unit consists of an oil temperature gage, oil pressure gage, and fuel pressure gage. Oil and fuel pressure, indicated in pounds per square inch (psi) is obtained through direct pressure lines from the engine to the indicator. Oil temperature is detected by an electrical resistance type temperature bulb operating from the aircraft electrical system and is indicated on each oil temperature gage in degrees Fahrenheit.

ENGINE COMBINATION GAGE UNITS. ▲3

Two engine combination gage units (2 and 3, figure 1-9) are provided, one for each engine, and are located in the upper right hand side of the instrument panel. Each unit consists of an oil temperature gage, oil pressure gage and a cylinder head temperature gage. Oil pressure, indicated in pounds per square inch (psi) is obtained through a direct pressure line from the engine to the indicator. Oil and cylinder head temperatures are detected by electrical resistance type temperature bulbs operating from the aircraft electrical system and are indicated on each oil and cylinder head temperature gage in degrees Fahrenheit.

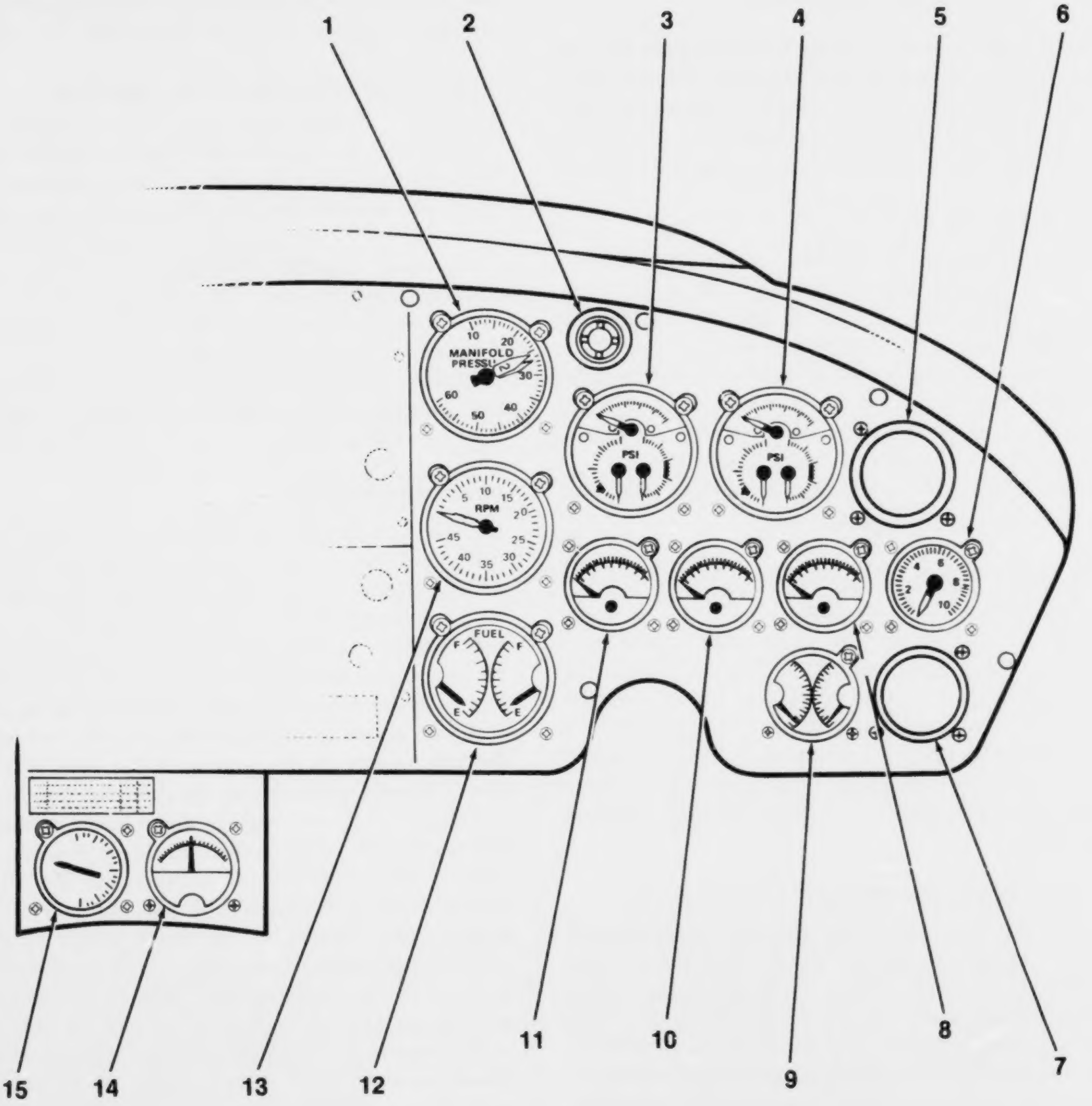
DUAL FUEL FLOW GAGE. ▲3

Fuel flow, in gallons per hour to each engine is indicated by a dual fuel flow gage (11, figure 1-9) located on the instrument panel. The dual fuel flow gage senses the pressure at which fuel is delivered to the engine fuel injection nozzles. Since fuel pressure at the nozzles Is a function of the fuel consumption of the engine, the gage is marked as a flowmeter. The gage dial is marked with arc segments corresponding to the proper fuel flow for various power settings and is used as a guide to quickly and accurately set the mixture. The gage has markings for power settings and takeoff settings for various altitudes. The takeoff markings indicate maximum performance takeoff mixture for the altitudes shown, making it practical to lean the mixture on a high altitude takeoff. In the cruise power range, the low-fuel flow edge of each segment is the normal-lean setting and the high-fuel flow edge is the best-power setting, for that percentage of power. In the takeoff and climb range, each segment represents a maximum-power mixture for an altitude range: the low-fuel flow edge is the setting for the marked altitude and the high-fuel flow edge is the setting for a thousand feet lower. The sea-level to 4000 feet segment represents a full rich takeoff power range. Two pointers marked 1 and 2, indicate the fuel-flow for the left and right engine respectively. The gage is a direct reading pressure gage.

Note

The fuel flow settings on the takeoff and climb power segment of the dial are for 2625 rpm and full throttle, only. Climb power settings at rpm lower than 2450 should be taken from the power schedule tables or computer and mixture adjusted to the low fuel flow side of the cruise power range.

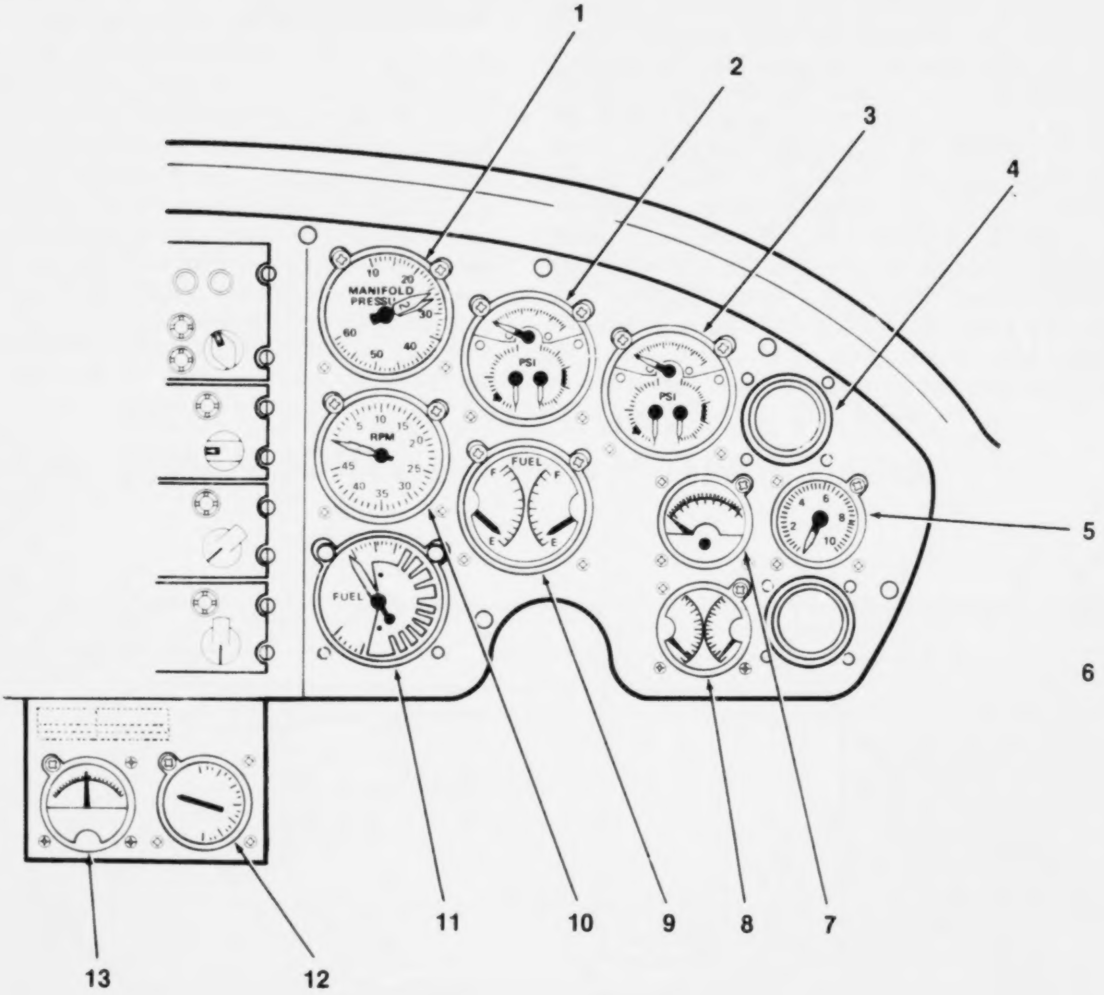
ENGINE AND MISCELLANEOUS INSTRUMENTS ▲▲



1. Dual Manifold Pressure Gage
2. Stall Warning Indicator Light
3. Left Engine Combination Gage Unit
4. Right Engine Combination Gage Unit
5. Additional Instrument Space
6. Suction Gage
7. Additional Instrument Space
8. Outside Air Temperature Gage
9. Auxiliary Tanks Fuel Quantity Indicator
10. Right Engine Cylinder Head Temp. Gage
11. Left Engine Cylinder Head Temp. Gage
12. Main Tanks Fuel Quantity Indicator
13. Dual Tachometer
14. Ammeter
15. Wing Flaps Position Indicator

Figure 1-8

ENGINE AND MISCELLANEOUS INSTRUMENTS ▲



1. Dual Manifold Pressure Gage
2. Left Engine Combination Gage Unit
3. Right Engine Combination Gage Unit
4. Additional Instrument Space
5. Suction Gage
6. Additonal Instrument Space
7. Outside Air Temperature Gage
8. Auxiliary Tanks Fuel Quantity Indicator
9. Main Tanks Fuel Quantity Indicator
10. Dual Tachometer
11. Dual Fuel Flow Gage
12. Wing Flaps Position Indicator
13. Ammeter

Figure 1-9

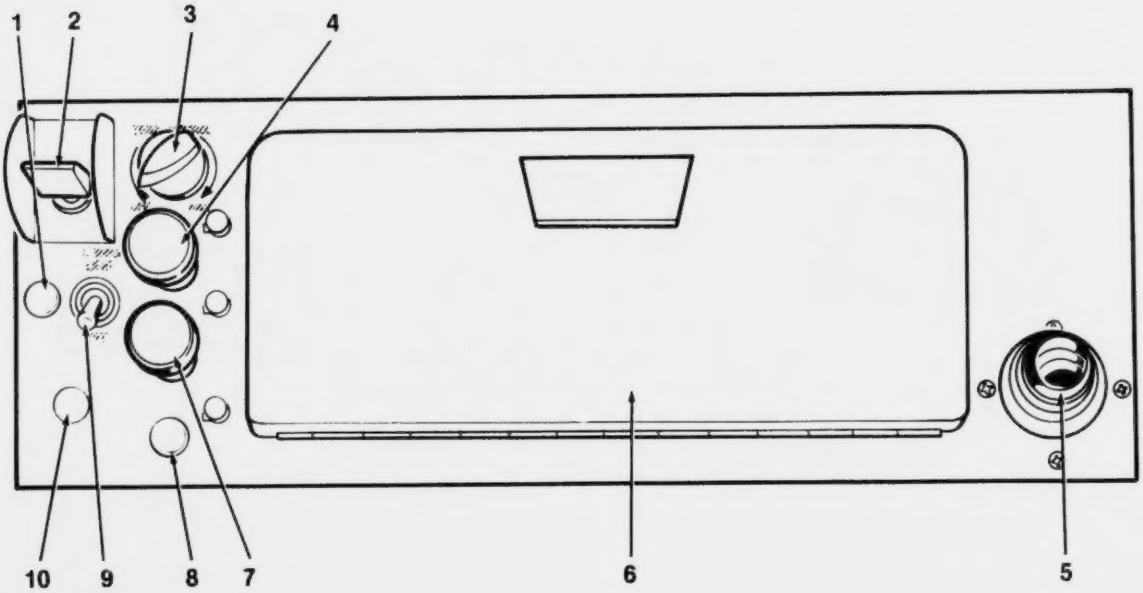
PROPELLERS.

The aircraft is equipped with two Hartzell designed, all metal, two-bladed, hydraulically operated constant speed, full feathering propellers. Propeller operation is controlled by the propeller levers through a mechanical linkage to the engine-driven propeller governor on each engine. A setting introduced into the governor by the pilot establishes the engine speed to be maintained and the governor then controls the flow of engine oil, boosted to high pressure by the governing pump, to or from the piston in the propeller hub. Oil pressure, directed against the piston in each propeller hub, moves the piston forward and a pitch change linkage, connected between the piston and blades, twists the blades toward low pitch (high rpm). When oil pressure from the governor to the propeller piston is relieved, centrifugal force, assisted by the feathering spring, acting on the propeller counterweights, twists the blades toward high pitch (low rpm).

PROPELLER LEVERS.

Control of engine rpm and propeller feathering is accomplished by operation of the two propeller levers (3, figure 1-4) located on top of the engine control pedestal, between the throttle and mixture levers. Placing the propeller levers in the INCREASE (full forward) position decreases the blade angle and provides the highest engine rpm setting. Safety detents are provided near the aft end of the lever travel to prevent accidental feathering of the propellers. Pulling the levers aft to the detent position (marked DECREASE) progressively increases the propeller blade angle and decreases engine

RIGHT SWITCH AND CONTROL PANEL ▲1 ▲2



1. Additional Switch Space*
2. Wing Flaps Switch
3. Cabin Air Temperature Control Knob
4. Cabin Air Knob
5. Copilot's Air Vent
6. Map Compartment
7. Defroster Knob
8. Additional Switch Space
9. Left Wing Light Switch
10. Additional Switch Space*

*Except Aircraft ▲4

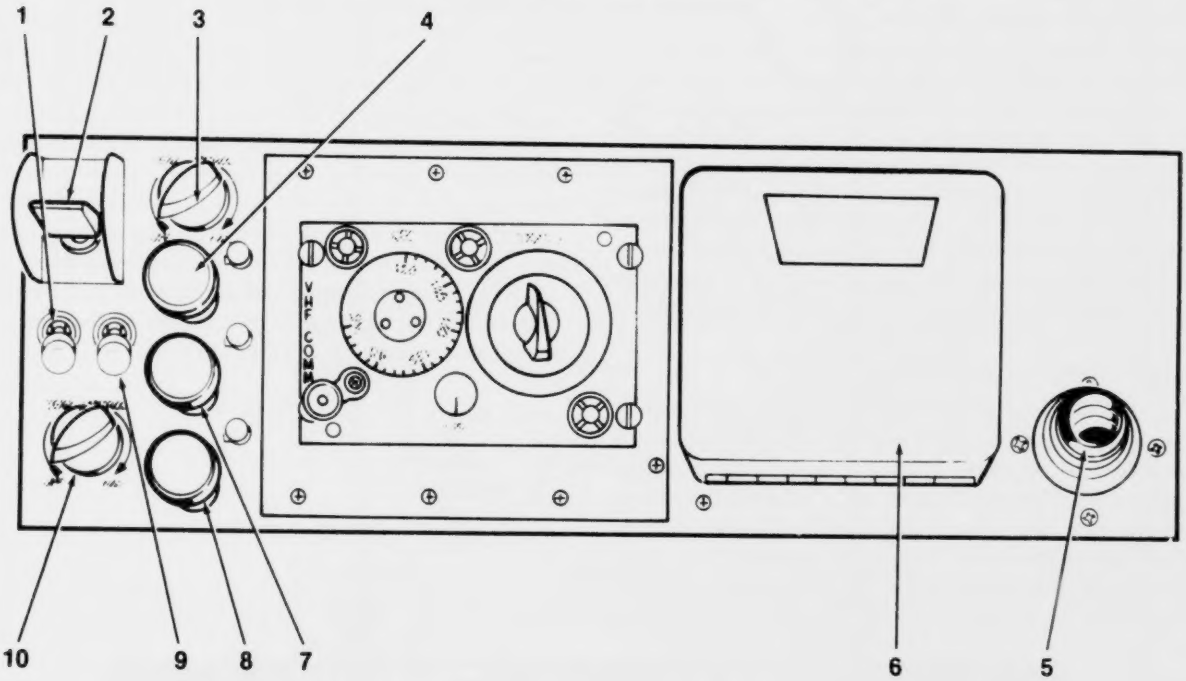
Figure 1-10

rpm. Movement of the levers past the detent to the FEATHER (full aft) position, relieves all oil pressure from the governing pump to the propeller piston, allowing the feathering spring to force the blades into the feathered position.

OIL SUPPLY SYSTEM.

Oil for the engine lubrication and propeller governor operation is supplied from a sump located at the bottom of the engine. Oil is picked up by the engine pump, forced through the oil thermostat, oil cooler, and then through the engine and propeller governor. Oil returns to the sump by gravity flow. Oil temperature is regulated automatically by thermostatically controlled oil coolers. On aircraft 1 and 2 the thermostats allow the oil to by-pass the oil coolers whenever the oil temperatures are below 150° F. On aircraft 3 and some aircraft 1 and 2, to prevent oil congealing in the oil coolers, warm oil circulates continuously through warm-up passages in the center of the coolers whenever the oil temperatures are below 170° F. Cool weather starting is made easier through the use of an oil dilution switch. An oil filler cap is located on top of each engine. Twelve U.S. quarts are required to fill each engine sump. Of this amount, six quarts are unusable. The oil supply for each engine is measured by a dipstick located on the left side of the engine. For servicing and oil specifications, refer to figure 1-2.

RIGHT SWITCH AND CONTROL PANEL 3



1. Propellers Anti-ice Switch*
2. Wing Flaps Switch
3. Cabin Air Temperature Control Knob
4. Cabin Air Knob
5. Copilot's Air Vent
6. Map Compartment
7. Defroster Knob
8. Forward Cabin Air Knob
9. Left Wing Light Switch
10. Propeller Anti-ice Rheostat Knob*

*Also on Aircraft 4

Figure 1-11

Note

To obtain correct oil level readings, it is important that the engines be shut down for at least five to 10 minutes prior to the oil check. This permits engine oil to drain out of the engine oil passages into the oil sump giving more accurate oil level reading. The minimum oil level for all takeoffs should be 11 quarts.

OIL DILUTION SWITCH

The oil dilution switch (22, figure 1-7), located on the left switch and control panel, has three positions: L (left engine), OFF, and R (right engine) when held to the L and R positions, it dilutes the oil in the left and right engines respectively. When the switch is released, it automatically returns to the OFF position. The switch electrically activates a solenoid valve which allows fuel to flow from the fuel system into the engine oil, thereby thinning the oil to make the next start easier. Refer to Section IX for oil dilution procedure.

FUEL SUPPLY SYSTEM.

Fuel for the engines is supplied by two independent fuel systems, one for each engine, with provisions for cross-feeding fuel from the main tanks to the opposite engines (see figure 1-13 and 1-14). Each system incorporates two fuel tanks (one main tank with vent in filler cap at the wing tip and an auxiliary tank with non-vented filler cap in the outer wing panel).

CAUTION

Extreme care must be exercised to insure that the main tank is fitted with a vented filler cap and that the auxiliary tank is fitted with a non-vented filler cap. This minimizes the possibility of fuel starvation and/or fuel syphoning.

Fuel for each engine is drawn from the respective tank through a fuel selector valve and fuel strainer by the engine-driven pump and fed to the carburetor on aircraft ▲1, ▲2 or fuel-air-control unit on aircraft ▲3. A vapor return line returns the unused fuel to the respective main tank whenever the engine is running. A submerged fuel boost pump is installed in each main fuel tank and serves as an auxiliary source of fuel pressure in the event of engine fuel pump failure and provides fuel pressure for priming and starting. On aircraft ▲1 ▲2 the fuel boost pumps must be used for heater operation when the engine is not running. The fuel boost pumps must also be used for oil dilution operation. Fuel boost pump switches and fuel selector valve handles are provided for control of the system. Two, dual-type fuel quantity gages, one for the main tanks and one for the auxiliary tanks are located on the instrument panel. The fuel tanks are individually serviced through filler caps located on top of the tanks. Refer to figure 1-12 for fuel quantity data and figure 1-2 for fuel specifications and grades. Refer to Fuel System, Section VII for additional information on the fuel system management.

FUEL Quantity Data

BASED ON STANDARD DAY CONDITIONS AND 6 POUNDS PER GALLON

TANKS	NUMBER OF TANKS	USABLE FUEL LIMITATION (EACH)	FULLY SERVICED (EACH)
MAIN	2	45 GALLONS (270 POUNDS)	51 GALLONS (306 POUNDS)
AUXILIARY	2	15 GALLONS (90 POUNDS)	15.5 GALLONS (93 POUNDS)

Figure 1-12

FUEL SYSTEM Schematic 1 2

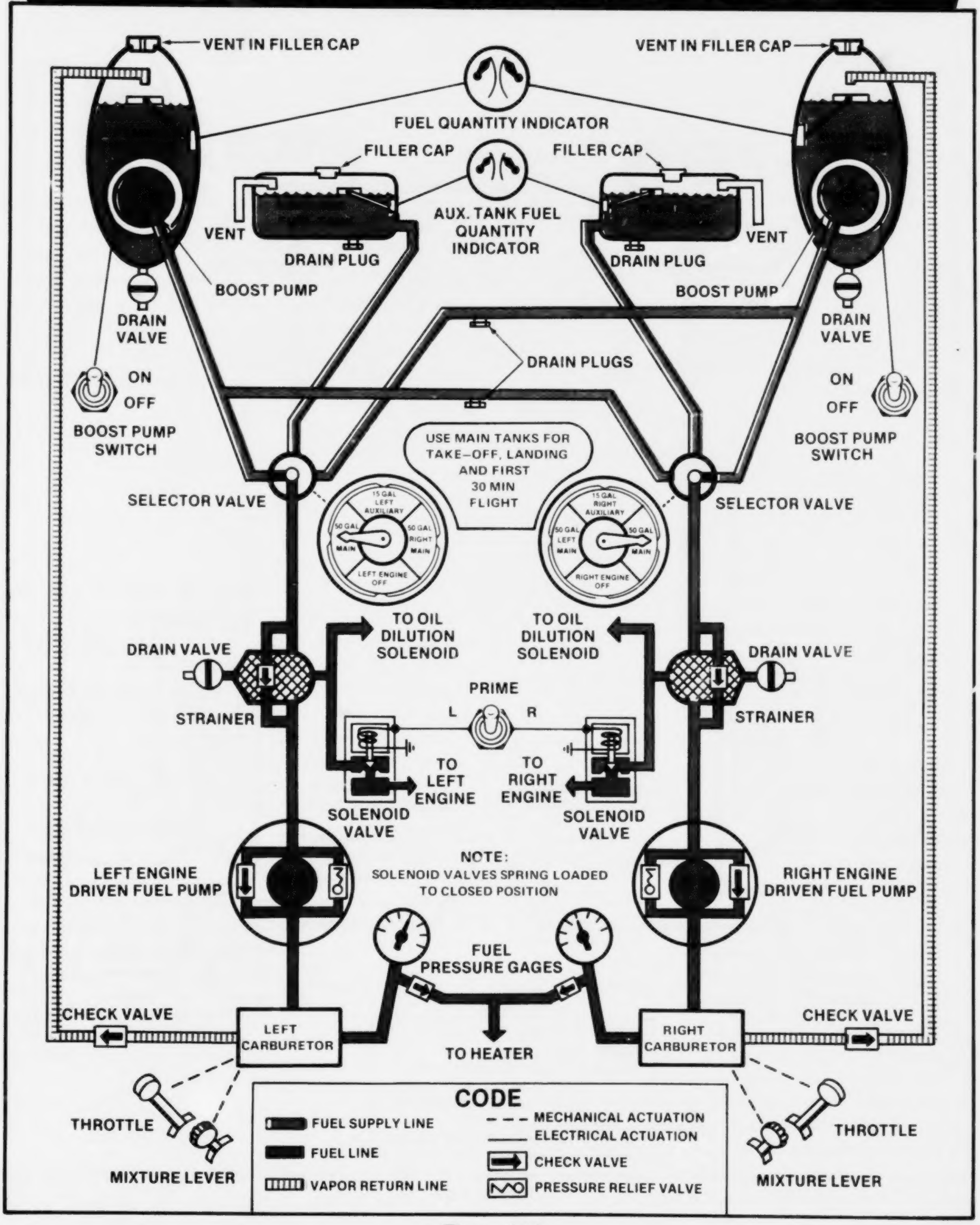


Figure 1-13

FUEL SYSTEM Schematic

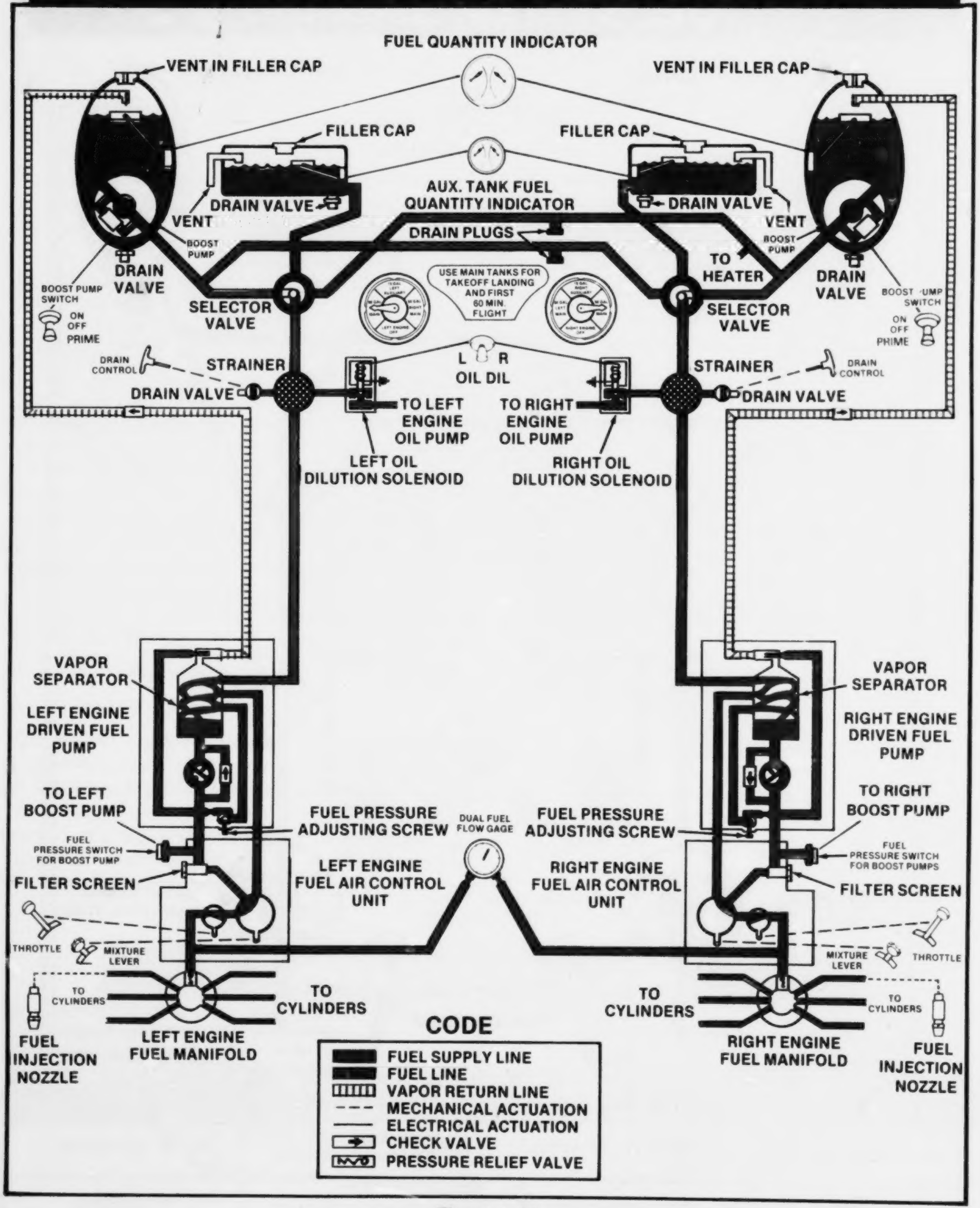


Figure 1-14

FUEL BOOST PUMP SWITCHES. 1 2

Two fuel boost pump switches (4 and 5, figure 1-7) are mounted on the left switch and control panel. The switches control the electrically-operated fuel boost pumps in the main fuel tanks. The switches are placarded L (left) and R (right) for the respective engine and have two positions; ON (up position) and OFF (down position).

FUEL BOOST PUMP SWITCHES. 3

Two fuel boost pump switches (4 and 5, figure 1-7) are mounted on the left switch and control panel. The switches control the electrically-operated fuel boost pumps in the main fuel tanks. The switches are placarded L (left) and R (right) for the respective engine and have three labeled positions ON, OFF and PRIME. The PRIME position runs the pumps at low speed, providing approximately nine gallons per hour of fuel flow for priming and starting. The ON position also runs the pumps at low speed, as long as the engine driven pumps are functioning. With the switch in the ON position, however if an engine-driven pump fails, the boost pump on that side will be switched to high speed automatically, providing sufficient fuel for all engine operations including takeoff power.

FUEL SELECTOR VALVE HANDLES.

The fuel selector valve handles (12 and 13, figure 1-4) are located between the front seats on the cabin floor. Each fuel selector valve handle has four positions. The positions for the left fuel selector valve handle are labeled LEFT MAIN, LEFT AUXILIARY, RIGHT MAIN, and OFF. The positions for the right fuel selector valve handle are labeled LEFT MAIN, RIGHT AUXILIARY, RIGHT MAIN and OFF. Positioning the handles at LEFT MAIN, LEFT AUXILIARY, RIGHT AUXILIARY, or RIGHT MAIN permits flow of fuel from the corresponding tank to the engine. Turning the handles to OFF shuts off all fuel to the engines. The selector handles are mechanically connected to the fuel selector valves located outboard of each engine nacelle. The fuel selector valve handles are used as the pointers for the fuel selector valves.

CAUTION

Care must be exercised on entering and leaving the cockpit to avoid stepping on the fuel selector valve handles.

Note

The fuel boost pumps do not supply fuel pressure to the carburetor on aircraft 1 2 or the fuel-air control unit on aircraft 3 when the fuel selector valves are placed on auxiliary tanks.

FUEL QUANTITY INDICATORS.

Two fuel quantity indicators (9 and 12, figure 1-8; 8 and 9, figure 1-9) are located at the lower right side of the instrument panel. The left indicator registers the fuel remaining in the main tanks and is labeled FUEL. The face of the left indicator has two dials, one for the left main tank and one for the right main tank. These dials are calibrated in gallons. The right indicator, labeled AUXILIARY FUEL, indicates the fuel quantity in the auxiliary tanks. The face of the right indicator has two dials, one for the left auxiliary tank and one for the right auxiliary tank. These dials are calibrated in gallons. Both the main tank and the auxiliary tank indicators are electrically operated and receive their signals from resistor-type transmitters in each tank. The fuel quantity indicator circuits operate from power supplied by the aircraft's electrical power supply system and are protected by a push-to-reset circuit breaker (25, figure 1-20; 25, figure 1-21) located on the circuit breaker panel. No low level warning devices are installed.

ELECTRICAL POWER SUPPLY SYSTEM ⚠1 ⚠2

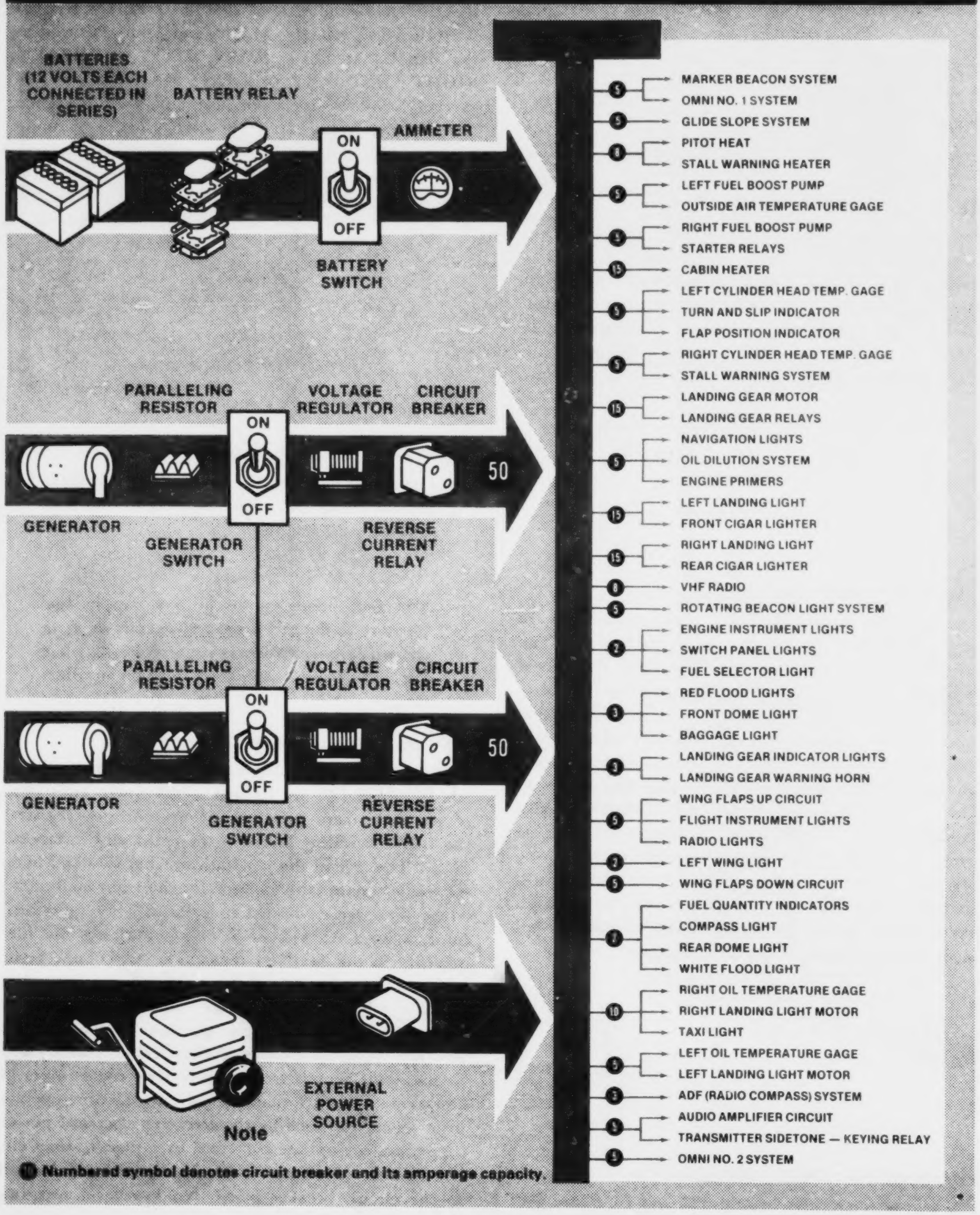
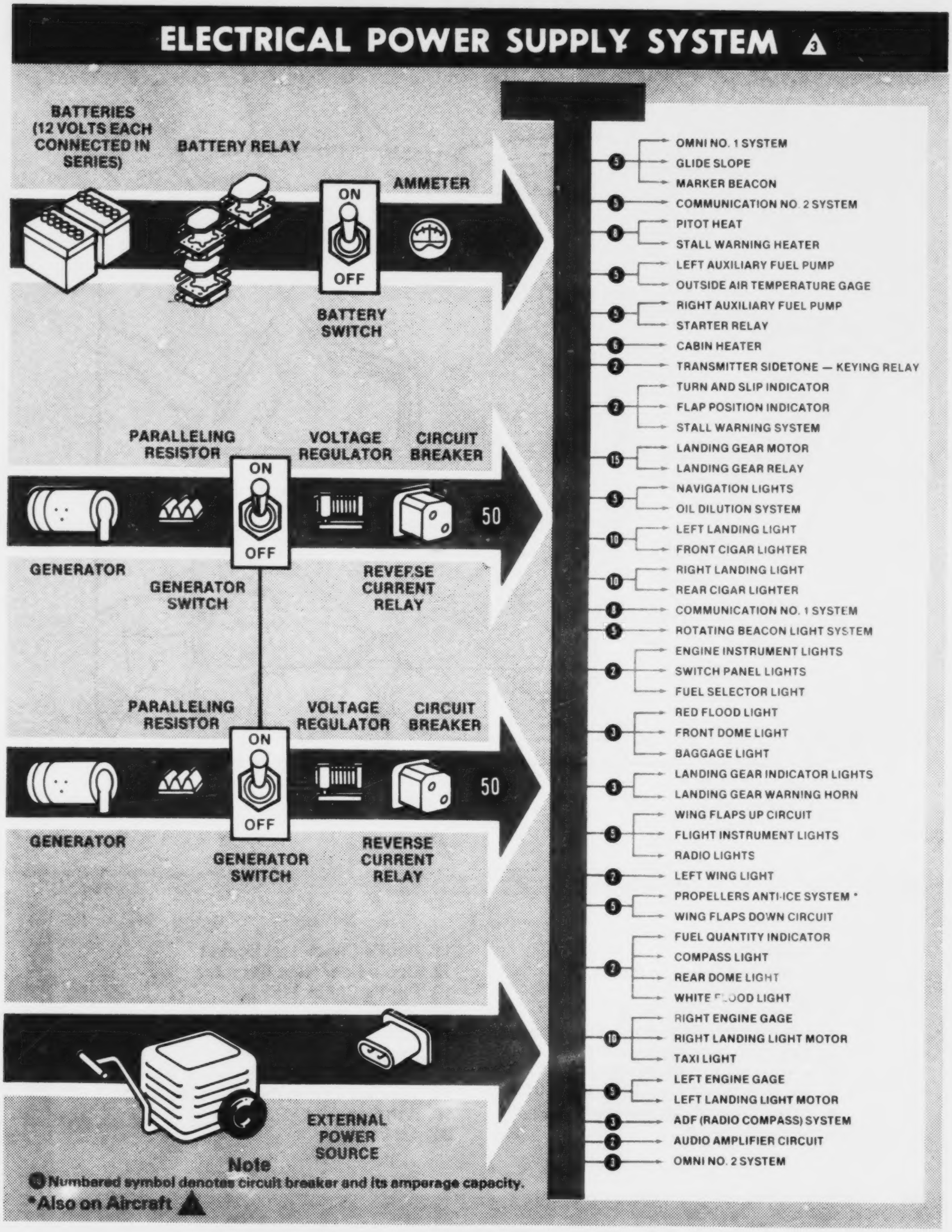


Figure 1-15



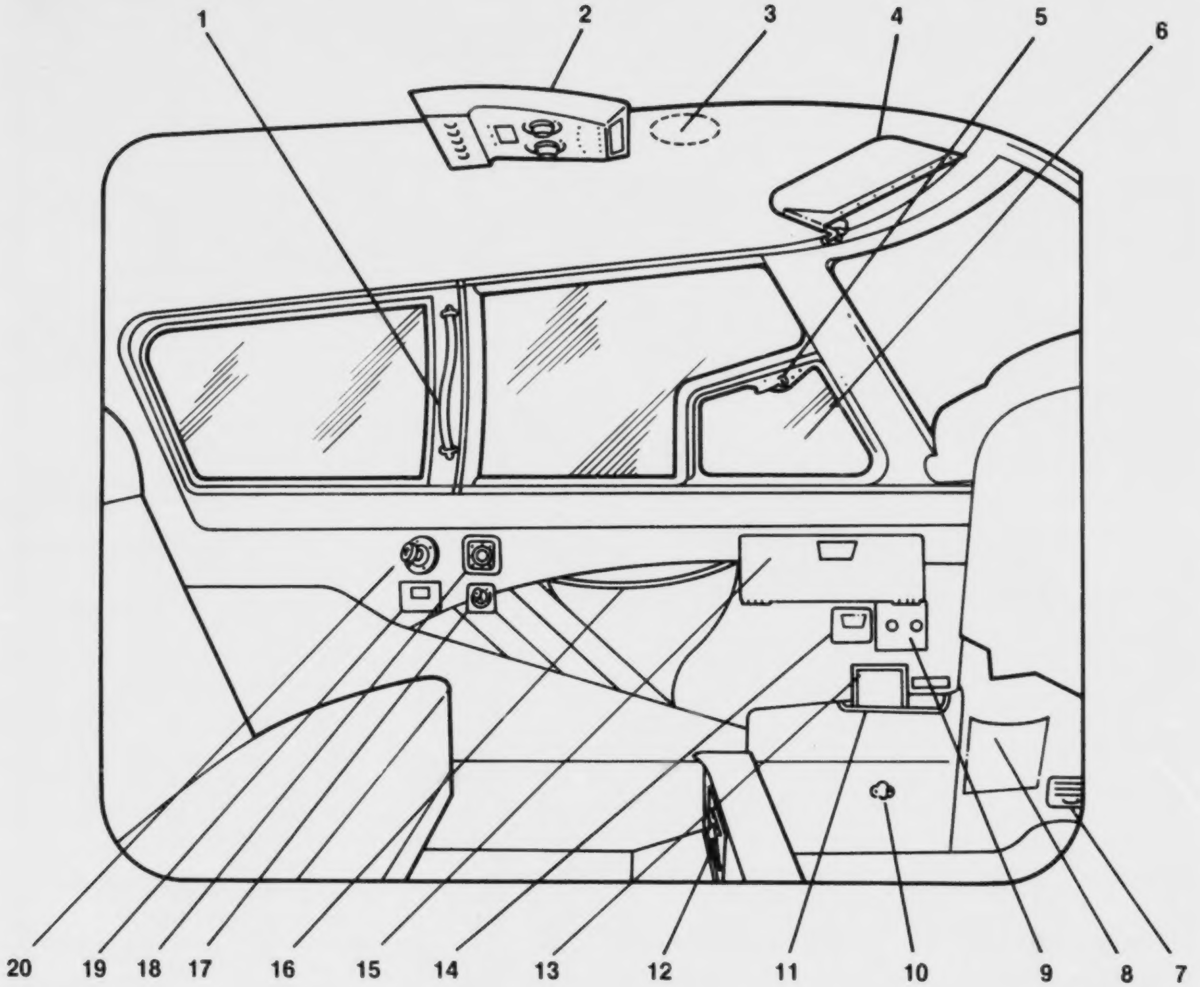
Note

⑤ Numbered symbol denotes circuit breaker and its amperage capacity.

*Also on Aircraft ③

Figure 1-16

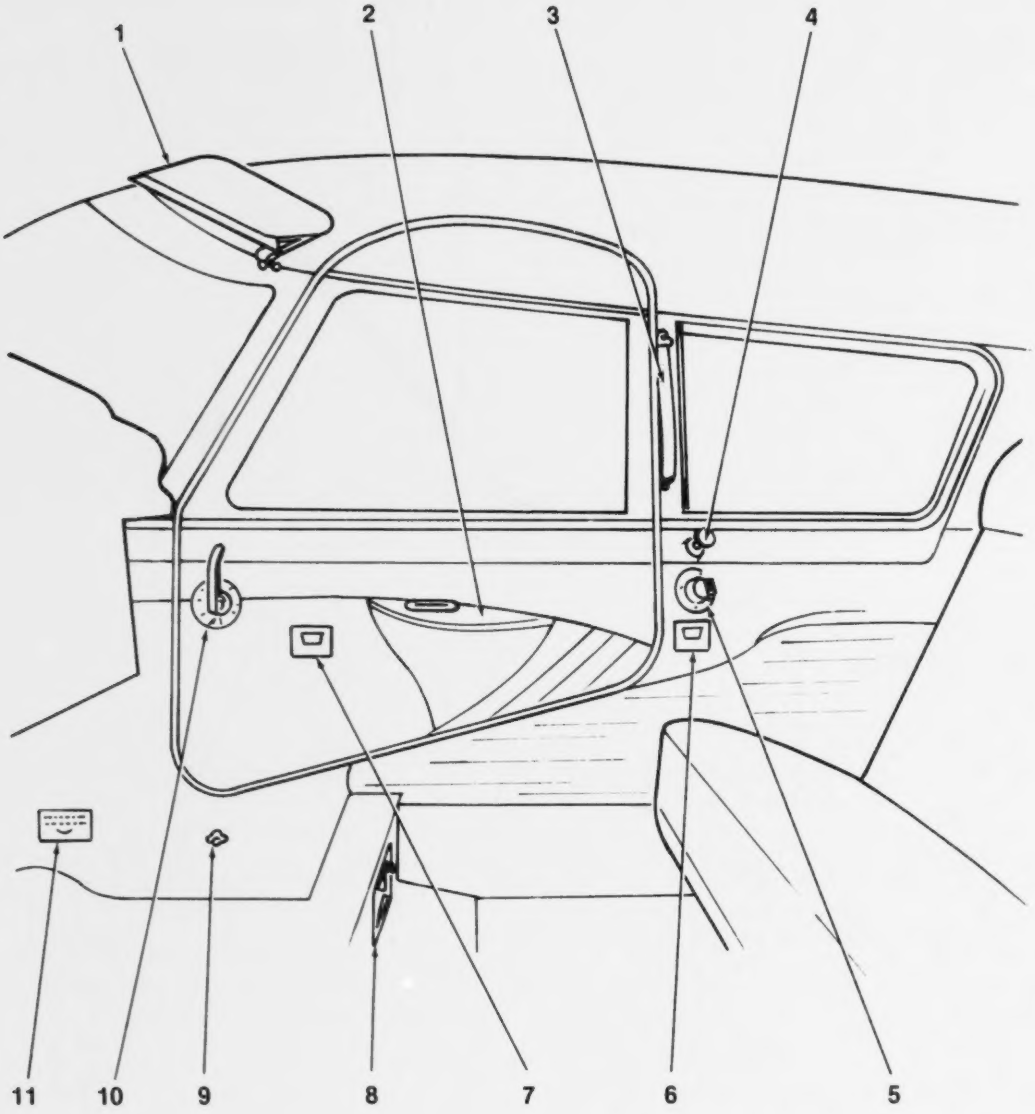
CABIN Left Side



1. Assist Strap
2. Overhead Console Panel
3. Cabin Speaker
4. Pilot's Sun Visor ▲ ▲
5. Pilot's Storm Window Latch Handle
6. Pilot's Storm Window
7. Pilot's Heat Register ▲
8. Aircraft Registration Pocket
9. Generator Circuit Breaker Panel
10. Headset Hook
11. Pilot's Check List Pocket
12. Cabin Rear Heat Register
13. Pilot's Check List
14. Ash Receiver
15. Circuit Breaker Panel
16. Arm Rest
17. Cigarette Lighter ▲
18. Window Emergency Release Ring
19. Ash Receiver
20. Air Vent

Figure 1-17

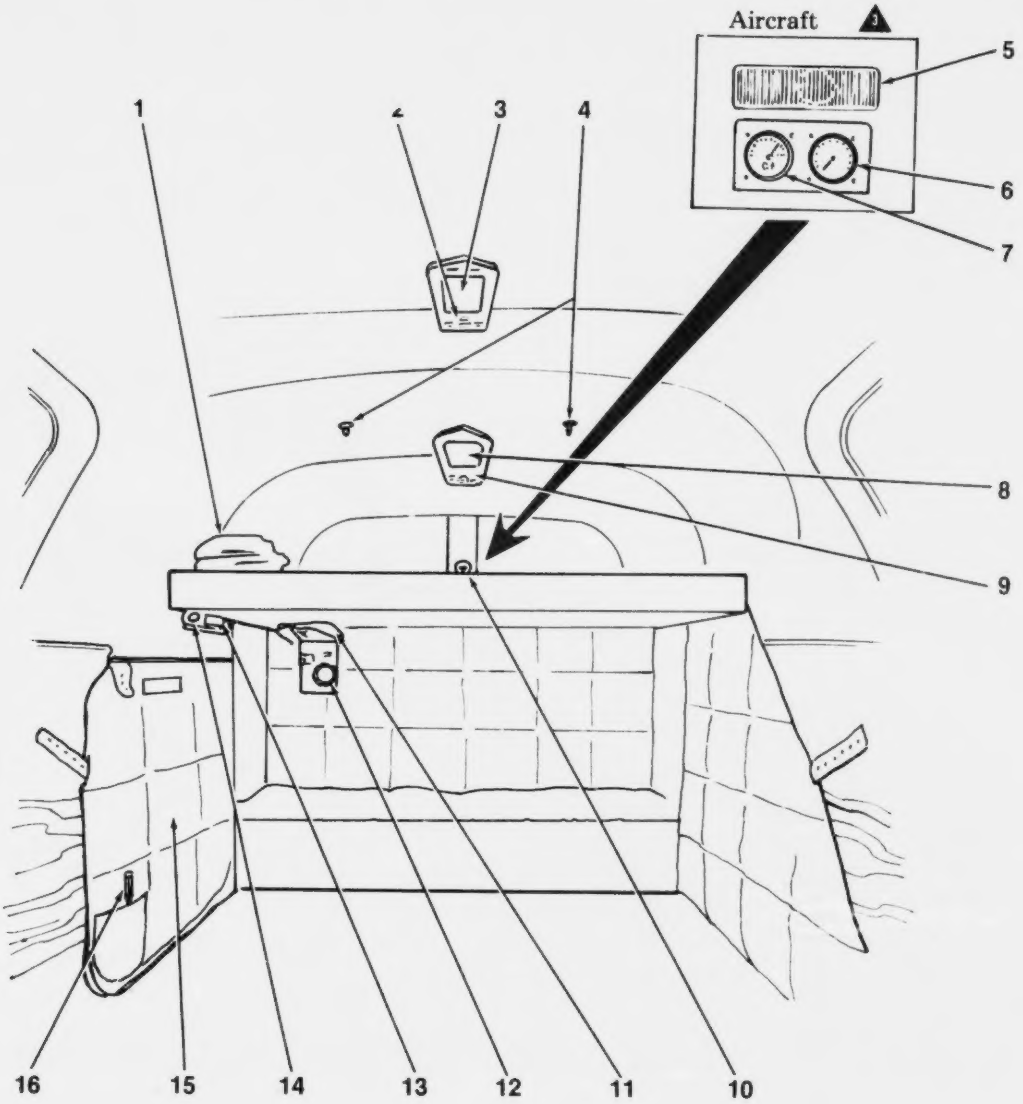
CABIN RIGHT SIDE



1. Copilot's Sun Visor ▲2 ▲3
2. Arm Rest
3. Assist Strap
4. Cigarette Lighter ▲1 ▲2
5. Air Vent
6. Ash Receiver
7. Ash Receiver
8. Cabin Rear Heat Register
9. Headset Hook
10. Interior Door Handle
11. Copilot's Heat Register ▲3

Figure 1-18

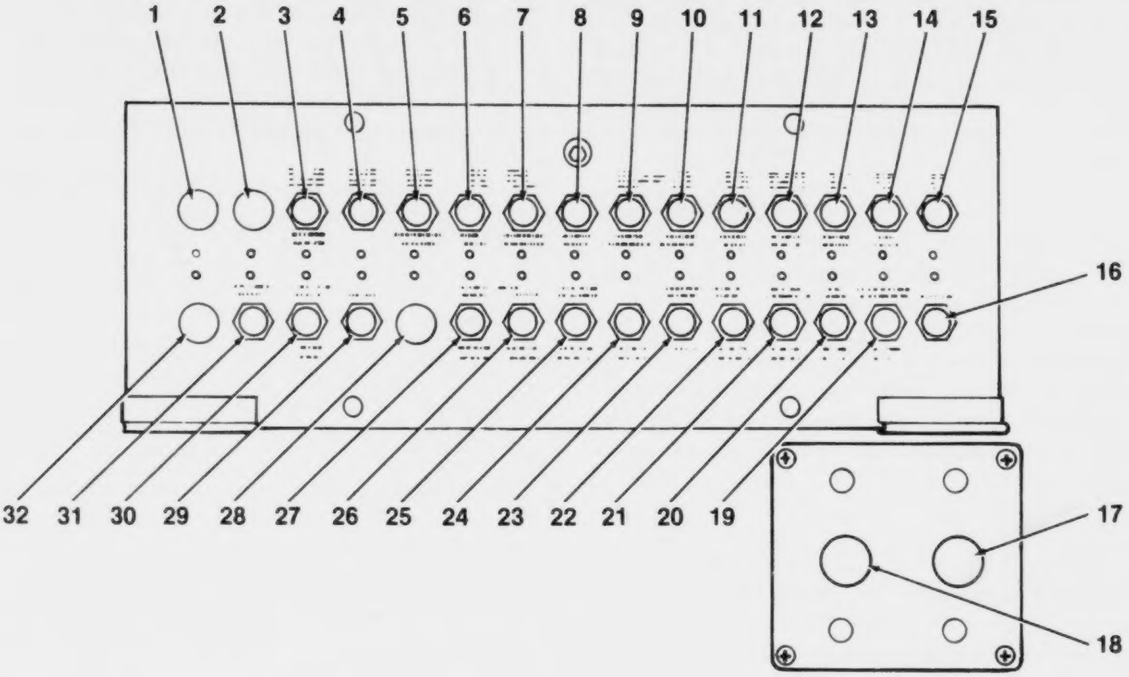
CABIN REAR VIEW



1. First Aid Kit
2. Dome Light Switch
3. Dome Light
4. Coat Hanger Hooks
5. Cabin Air Outlet 3
6. De-icing Cycle Gage 3
7. Oxygen Pressure Gage
8. Dome Light 3
9. Dome Light Switch 3
10. Oxygen Pressure Gage 1 2
11. Oxygen Control Valve Door 1 2
12. Oxygen Control Valve
13. Baggage Compartment Light
14. Baggage Compartment Light Switch 1 2
15. Baggage Compartment Door
16. Screwdriver

Figure 1-19

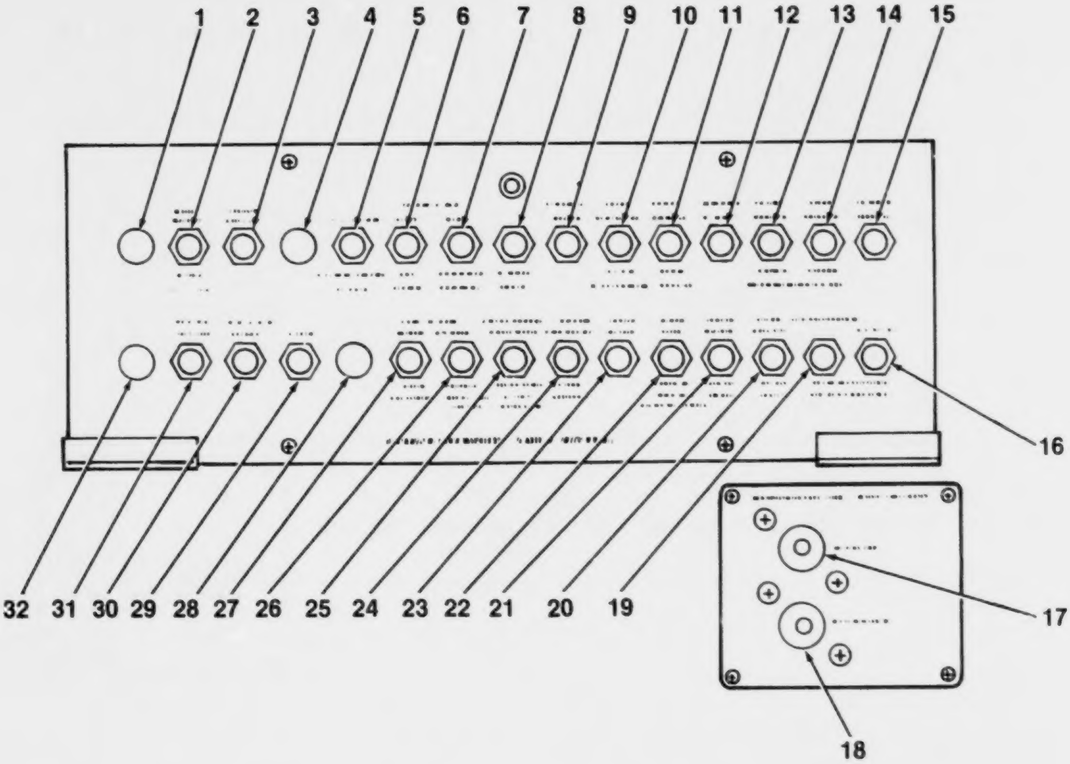
CIRCUIT BREAKERS ▲▲



1. Optional Circuit Breaker Space
2. Optional Circuit Breaker Space
3. Marker Beacon and Omni No. 1 Systems (5 amps)
4. Glide Slope System (5 amps)
5. Pitot Heat and Stall Warning Heat (8 amps)
6. Left Fuel Boost Pump and Outside Air Temperature Indicator (5 amps)
7. Right Fuel Boost Pump and Starter Relays (5 amps)
8. Cabin Heater (15 amps)
9. Left Cylinder Head Temp., Turn and Slip, and Flap Position Indicators (5 amps)
10. Right Cylinder Head Temp. and Stall Warning System (5 amps)
11. Landing Gear Motor and Landing Gear Relays (15 amps)
12. Navigation Lights, Oil Dilution System, and Engine Primers (5 amps)
13. Left Landing Light and Front Cigar Lighter (15 amps)
14. Right Landing Light and Rear Cigar Lighter (15 amps)
15. VHF Radio (8 amps)
16. Rotating Beacon Light System (5 amps)
17. Right Generator (50 amps)
18. Left Generator (50 amps)
19. Engine Instrument Lights, Switch Panel, Lights and Fuel Selector Light (2 amps)
20. Red Flood Lights, Front Dome Light, and Baggage Light (3 amps)
21. Landing Gear Indicator Lights and Warning Horn (3 amps)
22. Wing Flaps Up Circuit, Flight Instrument Lights, and Radio Dial Lights (5 amps)
23. Left Wing Light and De-Ice (2 amps)
24. Wing Flaps Down Circuit (5 amps)
25. Fuel Quantity Indicators, Compass Light, Rear Dome Light, and White Flood Light (2 amps)
26. Right Oil Temp. Indicator, Right Landing Light Motor, and Taxi Light (10 amps)
27. Left Oil Temp. Indicator and Left Landing Light Motor (5 amps)
28. Optional Circuit Breaker Space
29. ADF (Radio Compass) System (3 amps)
30. Audio Amplifier Circuit and Transmitter Sidetone -- Keying Relay (5 amps)
31. Omni No. 2 System (5 amps)
32. Optional Circuit Breaker Space

Figure 1-20

CIRCUIT BREAKERS ▲



1. Optional Circuit Breaker Space
2. Omni No. 1 Systems, Glide Slope and Marker Beacon (5 amps)
3. Communications No. 2 System (5 amps)
4. Optional Circuit Breaker Space
5. Pitot Heat and Stall Warning Heater (8 amps)
6. Left Auxiliary Fuel Pump and Outside Air Temperature Gage (5 amps)
7. Right Auxiliary Fuel Pump and Starter Relays (5 amps)
8. Cabin Heat (6 amps)
9. Transmitter Sidetone —Keying Relay (2 amps)
10. Turn and Slip Indicator, Flap Position Indicator and Stall Warning System (2 amps)
11. Landing Gear Motor and Landing Gear Relay (15 amps)
12. Navigation Lights and Oil Dilution System (5 amps)
13. Left Landing Lights and Front Cigar Lighter (10 amps)
14. Right Landing Lights and Rear Cigar Lighter (10 amps)
15. Communication No. 1 System (8 amps)
16. Rotating Beacon Light System (5 amps)
17. Left Generator (50 amps)
18. Right Generator (50 amps)
19. Engine Instrument Lights, Switch Panel Lights and Fuel Selector Lights (2 amps)
20. Red Flood Light, Front Dome Light, and Baggage Light (3 amps)
21. Landing Gear Indicator Lights and Landing Gear Warning Horn (3 amps)
22. Wing Flap Up Circuit, Flight Instrument Lights, and Radio Lights (5 amps)
23. Left Wing Light (2 amps)
24. Propellers Anti-Ice System* and Wing Flaps Down Circuit (5 amps)
25. Fuel Quantity Indicator, Compass Light, Rear Dome Light, and White Flood Light (2 amps)
26. Right Engine Gage, Right Landing Light Motor, and Taxi Light (10 amps)
27. Left Engine Gage, Left Landing Light Motor (5 amps)
28. Optional Circuit Breaker Space
29. ADF (Radio Compass System) (3 amps)
30. Audio Amplifier Circuit (2 amps)
31. Omni No. 2 System (3 amps)
32. Optional Circuit Breaker Space

* Also on Aircraft ▲

Figure 1-21

Note

> Should fuel syphoning occur from an auxiliary fuel tank it is possible that the fuel quantity indicator may show evidence of fuel remaining, when the auxiliary tank is empty. Refer to Fuel System, Section VII for additional information.

ELECTRICAL POWER SUPPLY SYSTEM.

Power for the aircraft's 24-volt direct current electrical system (see figure 1-15; and figure 1-16) is supplied by two 50-ampere engine-driven generators. Two 12-volt batteries (13, figure 1-2) connected in series, are located in the left wing just outboard of the engine nacelle. These batteries serve as a standby power source and supply current to the system when the generators are inoperative or when generator voltage is insufficient to close the reverse-current relays. The generators will supply current to the aircraft electrical power supply system whenever the engines are turning approximately 1400 rpm and above. An external power receptacle is provided to permit the use of an external power source.

EXTERNAL POWER RECEPTACLE

An external power receptacle (9, figure 1-2) with a spring-loaded access door is located just aft of the batteries, and is accessible from beneath the left wing. It is a 28-volt, AN standard type and is used to plug in a direct-current, external power source for starting the engines or for electrical ground checks. An external power source should be used whenever it is available to prevent needless drain on the batteries.

BATTERY SWITCH

A battery switch (2, figure 1-7) is installed in the left switch and control panel. When the battery switch is placed in the ON (up position) a solenoid switch is activated which closes the circuit between the batteries and the aircraft electrical system. The battery switch can be placed in the OFF (down position) to allow checking of the aircraft electrical power supply system for a malfunctioning circuit. If both generator circuits should become inoperative, all electrical equipment can be operated with the battery circuit. The length of time the battery circuit can be utilized in this manner depends on the condition of the batteries. Regardless of the condition of the batteries, however, this type of operation should be kept to a minimum and a landing effected as soon as practical and the cause of failure determined. The battery switch may also be turned OFF simultaneously with the two generator switches through the use of the hinged switch bar located above these three switches.

CONTROL LOCK

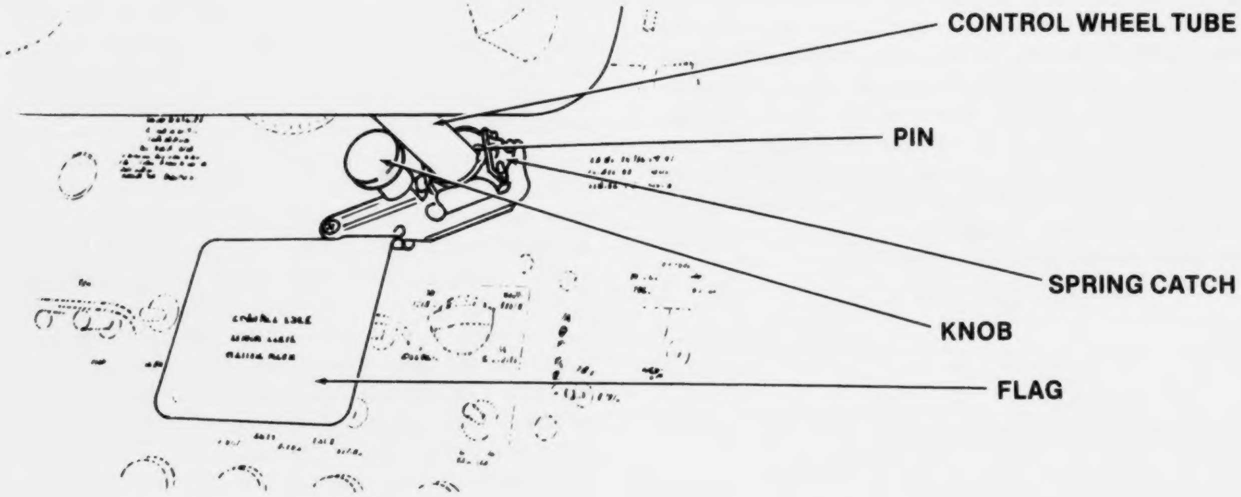


Figure 1-22

GENERATOR SWITCHES.

Two generator switches (1 and 3, figure 1-7) are provided on the left switch and control panel. These switches are grouped together with the battery switch under a hinged switch bar which allows them to be switched OFF simultaneously. The generator switches may also be switched OFF individually. They are OFF in the down position and ON in the up position. Placing the generator switches in the ON position connects the two generator systems and closes the circuits between the generators and the aircraft's electrical power supply system. In the event of a short circuit, the generator switches may be turned OFF and the engines will continue to run on their separate magneto-powered ignition systems. The separate generator switches also provide a means of checking a malfunctioning circuit and permit such a circuit to be cut off. If a generator circuit is found to be malfunctioning, that generator circuit switch should be turned OFF and operation of only the required electrical equipment continued on the remaining generator circuit.

CIRCUIT BREAKER.

All electrical circuits in the aircraft are protected by push-to-reset type circuit breakers. Circuit breakers for all circuits, except the two generator circuits, are mounted in a circuit breaker panel (see figure 1-20 and figure 1-21). The circuit breaker panel is covered by a metal door which may be opened by pulling out and down on the door knob. The two generator circuit breakers are located on a small panel (figure 1-20 and figure 1-21), slightly below the main panel. The name of each circuit on both panels is indicated at each circuit breaker. The panels are marked CIRCUIT BREAKERS —PUSH-TO-RESET. Should an overload occur in any circuit, the resulting heat rise will cause the controlling circuit breaker to open the circuit. After allowing the circuit breaker to cool for approximately three minutes, it may be pushed (until a click is heard or felt) to re-energize the circuit. However, the circuit breaker should not be held in if it opens the circuit a second time, as this indicates a short circuit and holding the circuit breaker in could result in fire or damage to the electrical system. On ▲3 aircraft, refer to Section IV for cabin heater overheat switch.

AMMETER.

An ammeter (14, figure 1-8; 13, figure 1-9) is installed in the center of the instrument panel. The ammeter indicates the battery charging and discharging rate in amperes.

FLIGHT CONTROL SYSTEM.

Primary flight control surfaces (ailerons, rudder and elevator) are controlled by dual control wheels and rudder pedals through a conventional cable system. On aircraft ▲3, a bungee interconnects the ailerons and rudder, for increased lateral stability in certain flight maneuvers.

CONTROL WHEELS.

The elevator and aileron surfaces are operated by conventional movement of the dual control wheels (16, figure 1-3). The control wheels are installed, one on each side of the instrument panel, to provide control from either the pilot's (left side) or copilot's seat.

RUDDER PEDALS.

The rudder and nose wheel steering are mechanically controlled by a cable system and braking is accomplished by means of a hydraulic system. Both systems are activated by conventional operation of the dual rudder pedals (13, figure 1-3) from either the pilot's or copilot's seat.

CONTROLS LOCK.

Positive locking of the elevator and aileron control surfaces may be accomplished by installing the controls lock (figure 1-22) provided for the purpose. To prevent operation of the aircraft when the controls lock is installed, a large red metal flag is incorporated in the controls lock assembly to cover the ignition switches and starter buttons. Installation of the controls lock may be accomplished by sliding the controls lock up under the pilot's control wheel socket on the instrument panel and inserting the locking pin through the outboard hole in the socket, through the hole in the control wheel tube, the inboard side of the socket and into the spring clip on the controls lock. The controls lock assembly may be removed by pulling the locking pin to the left until the controls lock assembly is disengaged. The controls lock is stowed in the map compartment during flight. If an external lock is not provided, the rudder may be locked by putting the nose wheel in the extreme right or left position.

TRIM TABS.

Trim tabs on the rudder, right elevator and left aileron are controlled by wheels, located on the engine control pedestal, through a conventional cable and pulley system to a screwjack and push-all tube which actuates the tabs.

Aileron Trim Tab Control Wheel.

The aileron trim tab control wheel (9, figure 1-14) is located on the face of the engine control pedestal. Rotation of the wheel clockwise (to the right), raises the tab on the left aileron and results in a roll to the right. Rotation of the wheel to the left results in a roll to the left. A tab position indicator (10, figure 1-4) is located immediately above the wheel and is labeled L (left roll), ROLL (NEUTRAL or center position) and R (right roll).

Elevator Trim Tab Control Wheel.

The elevator trim tab control wheel (16, figure 1-4) is mounted vertically on the left, or pilot's side, of the engine control pedestal. Rotation of the wheel aft, lowers the tab and results in a nose-up setting. Forward rotation of the wheel results in a nose-down setting. A tab position indicator (2, figure 1-4) is installed immediately to the right of the wheel and the label is marked NOSE DOWN, TAKEOFF and NOSE UP. A small arrow is placed in the TAKEOFF area to define the recommended setting for normal takeoffs.

Rudder Trim Tab Control Wheel.

The rudder trim tab control wheel (7, figure 1-4) is mounted in a horizontal positon on the face of the engine control pedestal. Counterclockwise rotation of the wheel deflects the tab on the left and results in a nose right setting. Clockwise rotation of the wheel results in a nose left setting. A tab position indicator (6, figure 1-4) is located just above the wheel and its positions are labeled LEFT (L, nose left), NOSE (NEUTRAL or center position) and RIGHT (R, nose right).

WING FLAP SYSTEM

Wings flaps of the split type are installed (two sections per wing) in the trailing edge of each wing between the fuselage and ailerons. The flaps are electrically operated by power from the aircraft electrical power supply system. A geared electric motor drives cables which, through a combination of bellcranks and push-pull rods, transmit the motion to the flaps. Limit switches on the geared electric motor prevent excessive travel of the system. The wing flaps may be extended to any angle between 0° and 45°. Approximately two seconds are required for the flaps to extend to 15° DOWN from the UP position, and 10 seconds are required for extension to 45° DOWN from the UP position. A period of one second is required for flap retraction from 15° DOWN, and five seconds is required for retraction from 45° DOWN. No emergency wing flap actuation system is provided. The flap actuator motor circuits are protected, in the event of an overload, by two push-to-reset circuit breakers (22, 24, figure 1-20; 22, 24, figure 1-21) (one for the up circuit and one for the down circuit) located on the circuit breaker panel.

LANDING GEAR EMERGENCY HAND CRANK

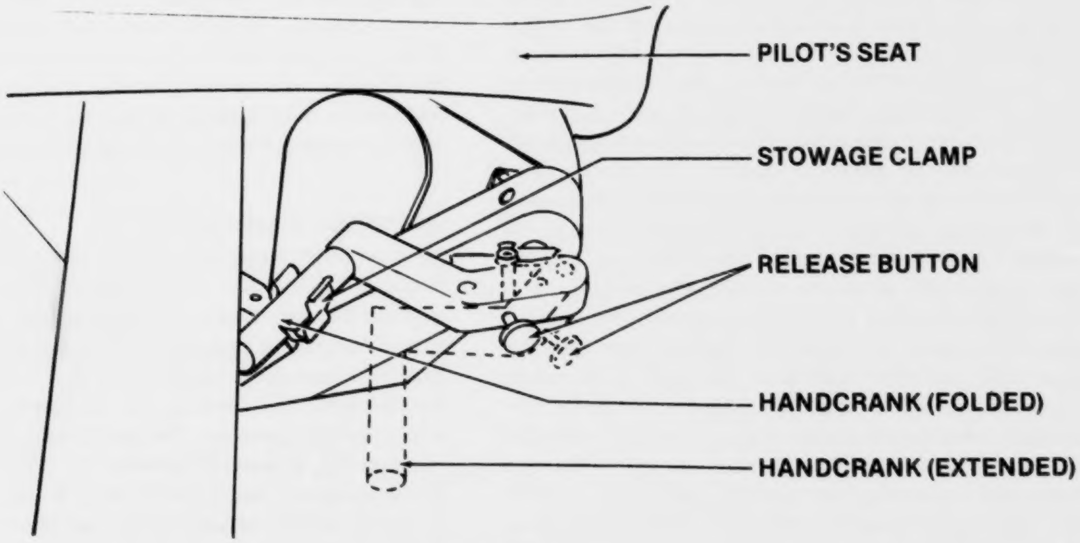


Figure 1-23

WING FLAP SWITCH.

Flap motor operation is controlled by a three-position switch (2, figure 1-10; 2, figure 1-11) which is located just to the right of the engine control pedestal on the right switch and control panel. It is identified by its airfoil shaped knob. The switch is spring-loaded from the UP and DOWN positions to the OFF(center) position. The flap switch knob is pressed to the UP or DOWN positions to raise or lower the flaps and permitted to return to the OFF (center) position to stop the flaps at the desired degree of extension.

WING FLAP POSITION INDICATOR.

The position of the wing flaps is shown by an electrically operated wing flaps position indicator (15, figure 1-8; 12, figure 1-9) mounted in the lower center portion of the instrument panel directly above the engine control pedestal. The wing flaps position indicator shows, in degrees, the position of the wing flaps at any angle from zero through 45°. The indicator is powered by the aircraft electrical power supply system through a position transmitter attached to the gearbox of the electric actuator motor. The flap position indicator circuit is protected by a push-to-reset type circuit breaker (9, figure 1-20; 10, figure 1-21).

LANDING GEAR SYSTEM.

The landing gear is of the fully retractable, tricycle type with a steerable nose wheel and two main wheels. Receiving its power from the aircraft electrical power supply system, a single, electrical motor drives the landing gear and doors through a gearbox and linkage consisting of push-pull tubes and bellcranks. Up and down limit switches are provided in the system and automatically stop the motor as the full up or down position is reached. A switch is located on the instrument panel to control the retraction and extension cycles. A safety switch, located on the left shock strut, opens whenever the weight of the aircraft is on the strut, thus preventing accidental retraction of the landing gear on the ground. Landing gear doors fully enclose the landing gear when retracted and are opened by mechanical linkage when the landing gear is extended. The strut doors remain open when the landing gear is extended, while the inboard gear doors reclose. When the retraction cycle is commenced, the inboard gear doors open to receive the landing gear into the gear well, and then close after the cycle is complete. Complete extension of the landing gear from the UP position takes approximately eight seconds. A period of 13 seconds is required to retract the gear. Position lights and a warning horn provide visual and audible gear position indications to the pilot. The landing gear can be extended manually with an emergency handcrank provided beside the pilot's seat. A push-to-reset circuit breaker (11, figure 1-20; 11, figure 1-21), located on the circuit breaker panel, protects the landing gear motor circuit in event of an overload. Refer to figure 7-2 or 7-3, Section VII for landing gear system schematic.

LANDING GEAR SWITCH.

The landing gear switch (13, figure 1-7) is located in the lower center portion of the instrument panel to the left of the engine control pedestal. It is identified by its small wheel-shaped knob. The switch must be pulled out before the switch can be moved from one position to another. When released the switch automatically locks in the slot of the selected position. The switch positions are UP, OFF, and DOWN. When the switch is OFF, the landing gear motor circuit is open. The switch should be placed in the OFF position when lowering the landing gear manually. When the switch is placed in the UP position, electric current flows from the bus bar through a limit switch and solenoid switch to the landing gear motor, the down locks are released, and the nose and main gears start retraction simultaneously.

Note

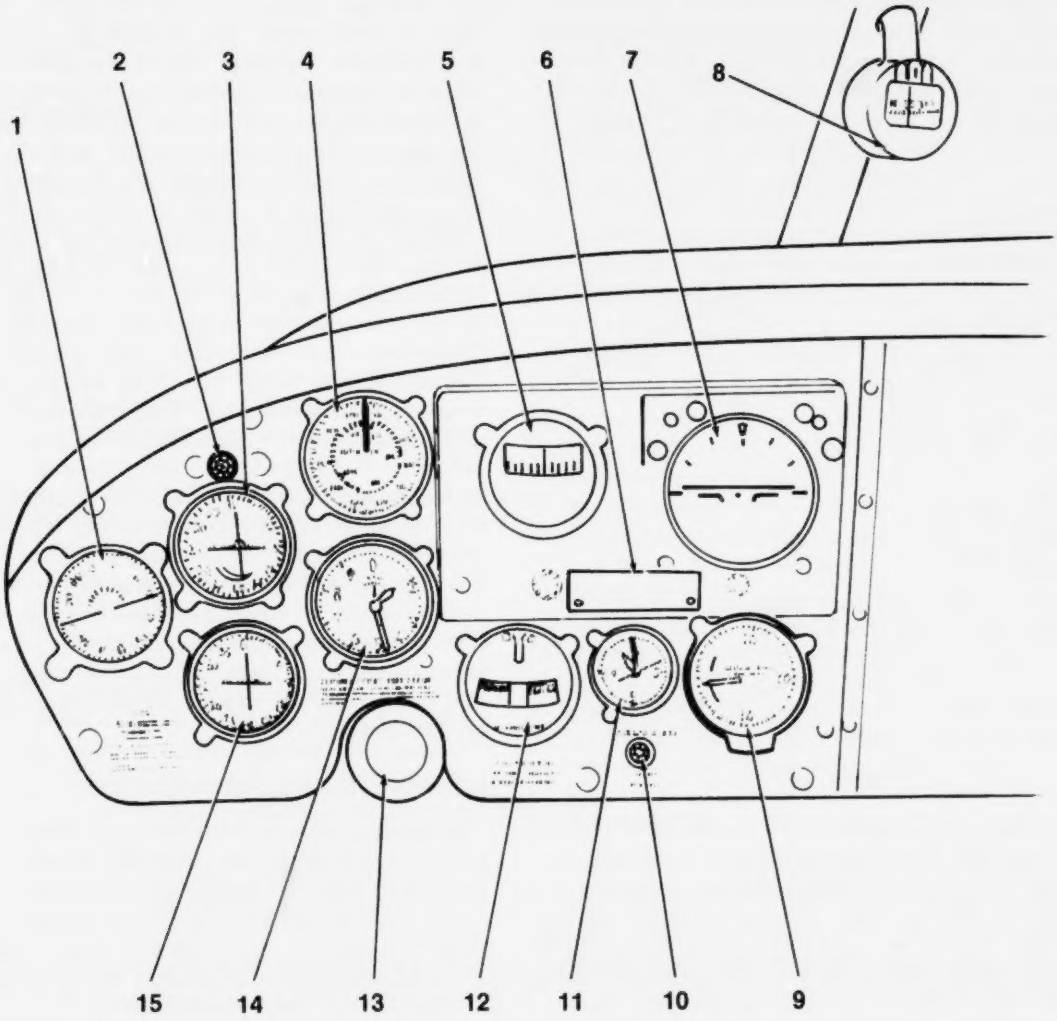
> The UP position of the switch is rendered ineffective by a safety switch whenever the weight of the aircraft is on the left shock strut.

When the nose and main gears are fully up, and up limit switch on the retraction gearbox disconnects the electric power from the motor and the nose and main gears are locked in the up position by up locks. When the switch is placed in the DOWN position, the landing gear motor is energized, the up locks are released, and the nose and main gears start down simultaneously. When the gears are fully down, the extension links travel to an over-center position resulting in a down lock action, and a down limit switch disconnects the electric motor from the electrical power supply system.

EMERGENCY HANDCRANK.

An emergency handcrank (see figure 1-23) is installed beside the pilot's seat to manually operate the landing gear mechanism should the landing gear motor fail to extend the gear. A lock release button is provided on the handle to unlock the handle from the extended position for stowage. When not in use, the handcrank is folded into a stowed position. The handcrank may be placed in operating or extended position by rotating the handle of the crank out and forward until it locks in position. A spring-loaded linkage locks the handcrank in the

FLIGHT INSTRUMENTS



1. Radio Compass Indicator
2. Marker Beacon Indicator Light
3. Course Indicator
4. Airspeed Indicator
5. Directional Indicator
6. Compass Correction Card
7. Attitude Indicator
8. Magnetic Compass
9. Vertical Velocity Indicator
10. Turn and Slip Indicator Test and Cabin Heater Overheat Indicator Light
11. Clock
12. Turn and Slip Indicator
13. Alternate Static Source Correction Placard
14. Altimeter
15. Course Indicator

Figure 1-24

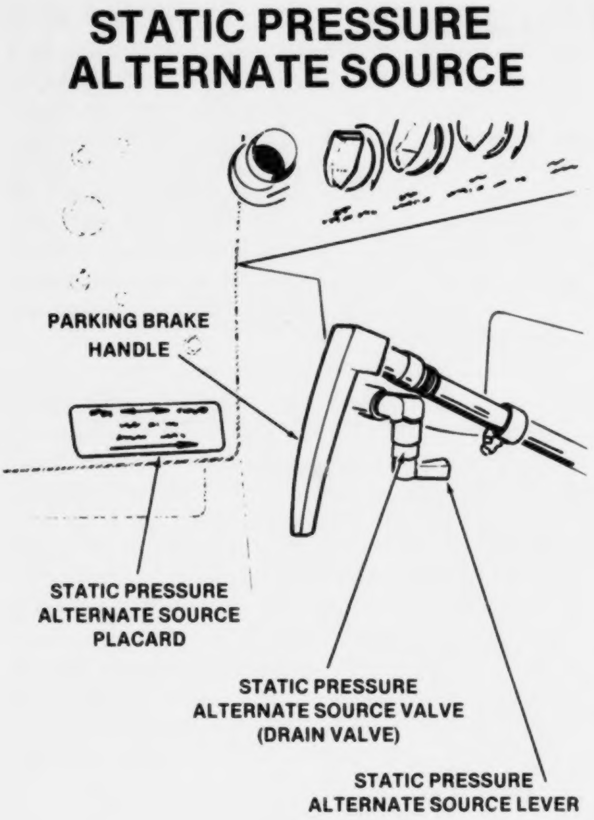

STATIC PRESSURE ALTERNATE SOURCE
PARKING BRAKE HANDLE
STATIC PRESSURE ALTERNATE SOURCE PLACARD
STATIC PRESSURE ALTERNATE SOURCE VALVE (DRAIN VALVE)
STATIC PRESSURE ALTERNATE SOURCE LEVER

Figure 1-25

operating position so that it will not inadvertently fold when in use. When the handcrank is pulled into operating position, a mechanical linkage disengages the actuator gearbox from the landing gear motor and engages it with the handcrank mechanism, however the landing gear switch must be in the OFF position during manual extension of the gear. Turning the handcrank operates the actuator gearbox through a chain, sprocket, and gear-drive mechanism. The handcrank can be stowed by pushing the lock release button to unlock the locking linkage and folding the handle in and aft. Refer to figure 7-4 for emergency handcrank schematic.

LANDING GEAR POSITION INDICATOR LIGHTS.

Two landing gear position lights (12, 14, figure 1-7) are provided, one above and the other below the landing gear switch. On aircraft ▲1, the landing gear position indicator lights automatically dim when the navigation lights are ON due to a resistor in the navigation light circuit. On aircraft ▲2 ▲3 , the resistor has been eliminated and the landing gear position indicator lights are of the push-to-test type and contain shutters for dimming. Clockwise rotation of the lens holder on lights closes the shutters permitting only a diffused ring of light to be transmitted through the lens. With the shutters in the open position (lens holder rotated counterclockwise), illumination of the light is unobstructed. The upper light is red, and is on at all times when the gear is fully retracted. The lower light is green, and illuminates only when all landing gears are fully extended and locked. The green light is connected in series with three down indicator switches, one on each wheel strut. If only one of the landing gears is not fully extended and locked, the green light will not illuminate. When neither light is on, the landing gear is in an intermediate position. The indicator lights draw their power from the bus bar. The circuit is protected by a push-to-rest type circuit breaker (21, figure 1-20; 21, figure 1-21) located on the circuit breaker panel.

LANDING GEAR WARNING HORN.

The landing gear warning horn is controlled electrically by the throttles and will sound if either throttle is retarded below approximately 12 inches of manifold pressure while the landing gear is not in the down position. A flasher unit is provided in the warning horn circuit which makes the horn sound intermittently. The warning horn is also electrically connected to the UP position of the landing gear switch, and will sound if the switch is placed in the UP position while the aircraft is on the ground. The power for the warning horn is drawn from the bus bar and passes through a push-to-reset type circuit breaker (21, figure 1-20; 21, figure 1-21).

On aircraft ▲1 the warning horn is connected through the nose gear down indicator switch and will cease sounding when the nose gear is down and locked. However, either one or both main gears may not be down and locked. On aircraft ▲2 ▲3 the warning horn is connected through the down limit and the nose gear down indicator switch and will cease to sound when the nose gear is down and locked or when the down limit switch has been actuated. If the landing gear is malfunctioning, the absence of the warning horn does not necessarily mean the landing gear is down and locked. The down indicator light is the only indication that all gears are down and locked.

STEERING SYSTEM.

The nose wheel is steerable with the rudder pedals up to 15°, either right or left of center, after which it becomes free-swiveling up to a maximum deflection of 55° right or left of center. Refer to figure 2-2 for the turning radius of the aircraft.

Note

> Do not turn the aircraft with one wheel locked unless absolutely necessary. Doing so causes tire scuffing and wear.

The steering linkage automatically disconnects from the nose wheel as the wheel is retracted, and the nose wheel is automatically straightened as it goes into the wheel well.

BRAKE SYSTEM.

The hydraulic brakes on the main wheels are conventionally operated by applying toe pressure to the pilot's or the copilot's rudder pedals. Depressing the pedals actuates the brake cylinders, resulting in a braking action of the main landing gear wheels. The brakes also may be set by operation of the parking brake handle mounted on the left cabin wall under the instrument panel.

BRAKE PEDALS.

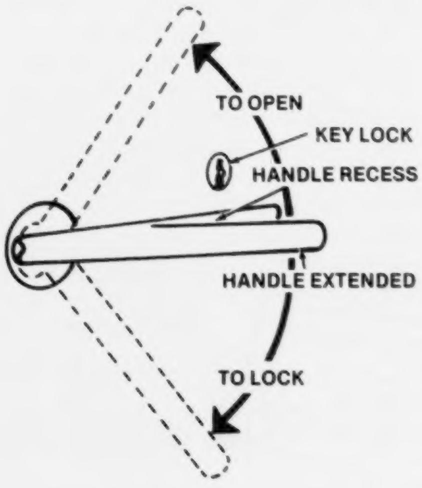
Conventional toe-type brake pedals (13, figure 1-3) consists of the upper part of the pilot's and copilot's rudder pedals. A hydraulic brake cylinder is mounted directly on each of the pilot's brake pedals. The copilot's brake pedals are connected by mechanical linkage to the pilot's brake pedals; thus pressure applied to the copilot's pedals is mechanically transmitted to the pilot's pedals. Operation of the pilot's pedals actuates the brake cylinders which hydraulically actuate the main wheel brake cylinders. Refer to brake Operation, Section VII.

PARKING BRAKE HANDLE.

The parking brake handle (14, figure 1-3) is located below the instrument panel on the left cabin wall. It is connected to the pilot's rudder pedals with cables. When parking brake handle is pulled and set, it pulls the pilot's rudder pedals down, thus applying the brakes at the main landing gear wheels. Applying foot pressure to the brake portion of the rudder pedals, as the parking brake handle is pulled, aids in applying the brakes. The parking brake mechanism has a ratchet device which holds the handle in any applied position. Turning the handle in a counter clockwise direction releases this ratchet, allowing the spring-loaded parking brake handle to retract and release the brakes.

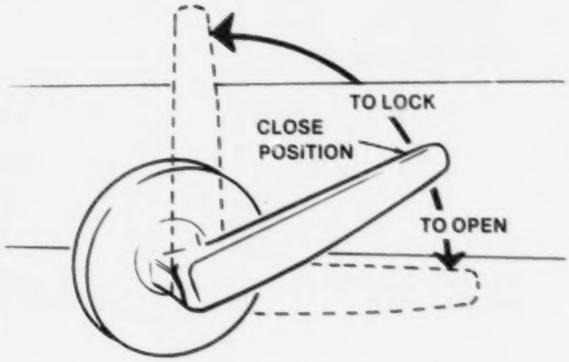
INSTRUMENTS.

All instruments except the magnetic compass, oxygen pressure gage and de-icing cycle gage on aircraft ▲3 ▲4



EXTERIOR DOOR HANDLE

Figure 1-26



INTERIOR DOOR HANDLE

Figure 1-27

are located on the shock-mounted instrument panel. Post-type lighting is provided to illuminate the fluorescent markings and pointers on all panel mounted instruments. Only those instruments which cannot be considered to be part of a complete system are covered under this paragraph. All other instruments are described with their related system. Refer to Section IV for coverage of all radio navigation instruments.

FLIGHT INSTRUMENTS.

All flight instruments (figure 1-24) are located on the left side of the instrument panel directly in front of the pilot. They consist of an airspeed indicator, vertical velocity indicator, altimeter, directional indicator, attitude indicator and turn-and-slip indicator.

CAUTION

The installed altimeter is a commercial type instrument and does not include the striped area.

PITOT-STATIC SYSTEM.

The pitot-static system supplies air pressure to operate the airspeed indicator; the static portion of the system supplies the operating pressures for operation of the vertical velocity indicator and the altimeter. The pitot-static system is composed of an electrically heated pitot tube, mounted on the nose, an external static port, located on each side of the fuselage aft of the baggage compartment and the associated plumbing necessary to connect the instruments to the sources.

Static Pressure Alternate Source Valve.

A static pressure alternate source valve (figure 1-25) is installed in the static system for use when the external sources are malfunctioning. This valve also permits drainage of condensate from the static lines. The static pressure alternate source valve is located adjacent to the parking brake handle. The valve is OPEN (alternate source) when the lever is pulled aft. It is CLOSED (normal source) by pressing the lever forward. An alternate static source correction placard (13, figure 1-24 and figure 7-1) is installed on aircraft ▲2 ▲3 on the left side of the instrument panel and gives airspeed and altimeter errors which will be encountered when operating on the alternate source. Refer to Alternate Static Source Valve Operation, Section VII.

PITOT HEAT SWITCH.

A pitot heat switch (20, figure 1-7) is provided at the bottom of the left switch and control panel. The switch is labeled PITOT HEAT and is ON in the up position and OFF in the down position. When the switch is placed in the ON position the heating elements in the pitot tube and the stall warning transmitter are electrically heated to maintain proper operation of the systems during icing conditions. When no pitot heat is required, the switch should be left in the OFF position.

CAUTION

Always place the pitot heat switch in the OFF

PILOT AND COPILOT SEATS

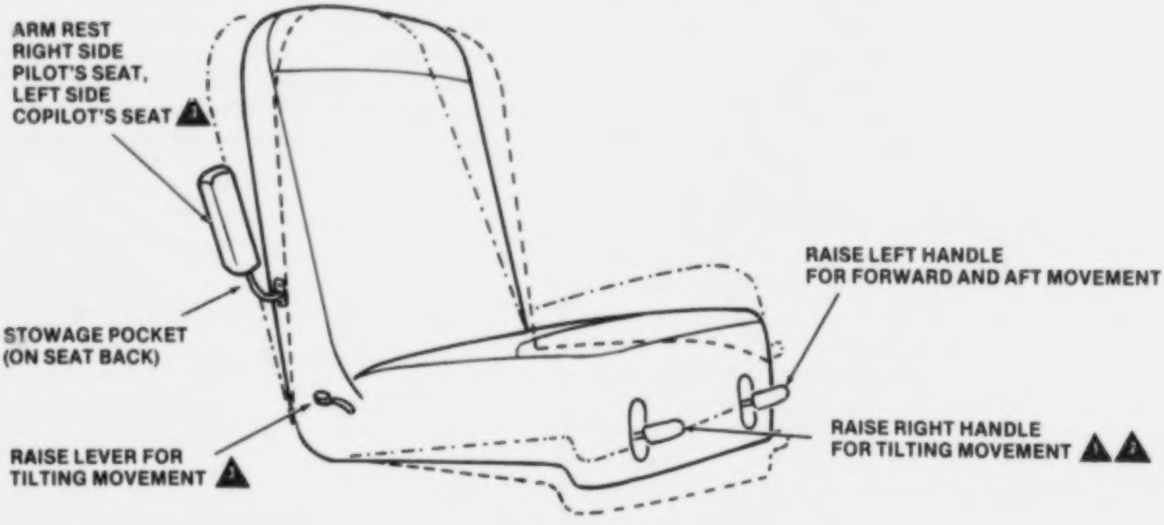


Figure 1-28

position while on the ground to prevent overheating of the heating element.

The pitot heat and stall warning heat circuits are protected by a push-to-reset type circuit breaker (5, figure 1-20; 5, figure 1-21).

VACUUM SYSTEM.

The vacuum system creates air velocities necessary to operate the attitude indicator and the directional indicator. The vacuum system consists of two engine-driven air pumps, a filter, oil separators, a vacuum relief valve, a suction gage, a vacuum indicator selector valve, and associated plumbing necessary to connect the instruments.

Attitude Indicator.

The attitude indicator (7, figure 1-24), incorporates a miniature aircraft adjusting knob. Rotation of the knob to the right or left will raise or lower the miniature aircraft in relation to the artificial horizon thus permitting compensation for changes in aircraft load configurations. A caging knob is not provided for the attitude indicator as the operating limits of the indicator will not be exceeded during normal operation. After the engines have been started it will require approximately five minutes for the gyro to reach operating speed.

CAUTION

The attitude indicator is limited to 100° of bank and 70° of pitch.

Note

Instrument error during acceleration is negligible in this aircraft.

Directional Indicator.

The directional indicator (5, figure 1-24) incorporates a caging knob for use in caging and correcting the setting with reference to the magnetic compass. The directional indicator setting may be corrected by gently pushing in on the caging knob, until the caged flag is visible in the right side of the indicator window, and rotating the knob to the right or left until the card indicates the same heading as the magnetic compass, and then pulling the knob straight out to avoid turning the card from the desired setting. After the engines have been started it will require about five minutes for the gyro to reach operating speed.

CAUTION

The operating limits of the directional indicator are 55° of pitch and bank.

Vacuum Indicator Selector Valve

The vacuum indicator selector valve, push-to-turn type, knob (10, figure 1-7) is located directly below the pilot's control wheel tube on the left switch and control panel. This knob can be turned without pushing in but should be depressed to avoid undue valve wear. The vacuum indicator positions for the selector valve knob are DIR GYRO (directional indicator), HOR GYRO (attitude indicator), L SOURCE (left pump) and R SOURCE (right pump). When the knob pointer is pushed and turned to the DIR GYRO or the HOR GYRO positions, a pressure indication of 4.75 to 5.25 inches Hg should be observed on the suction gage. When checking the L SOURCE and R SOURCE positions for pump operation, an indication higher than the GYRO readings should be observed.

TURN-AND-SLIP INDICATOR.

The turn-and-slip indicator is of the four minute type and is electrically operated by the aircraft electrical power supply system when the battery switch in ON or when an external power source is connected. When the needle is aligned with either the left or right turn rate scale, this is an indication of a standard rate turn. The turn-and-slip indicator circuit is protected by a push-to-reset type circuit breaker (9, figure 1-20; 10, figure 1-21). A push-to-test type amber light (10, figure 1-24) is provided in the turn-and-slip indicator circuit. When the light shield is pressed the light will illuminate if the turn-and-slip indicator circuit is operating. During normal operation the light also serves as a cabin heater, overheat warning light and is marked HEATER-OVERHEAT, T & B TEST.

STALL WARNING SYSTEM.

The stall warning system may be activated anytime electrical power is supplied to the DC Bus and provides protection from inadvertent stalls in that it gives a warning whenever a stall is approached regardless of speed, attitude, altitude, acceleration, load or other factors which change the stalling speeds. The stall warning horn is set to give a warning approximately five to 10 mph above the stalling speed and sounds a steady tone which makes it distinguishable from the gear warning horn which sounds intermittently. In addition, aircraft ▲ ▲ have a red stall warning light (2, figure 1-8) located in the upper right portion of the instrument panel, that operates concurrently with the horn. The stall warning transmitter mounted on the left wing leading edge, incorporates a heater element to prevent ice from hampering its operation. The heater element is controlled by the pitot heat switch (20, figure 1-7). The stall warning system electrical circuit is protected by a push-to-reset circuit breaker (10, figure 1-21).

CLOCK.

An eight-day, stem-wound clock (11, figure 1-24), incorporating a full-sweep second hand is installed in the instrument panel between the turn-and-slip indicator and the vertical velocity indicator.

OUTSIDE AIR TEMPERATURE GAGE.

An outside air temperature gage (8, figure 1-8; 7, figure 1-9) is located on the right side of the instrument panel slightly above the copilot's control wheel tube. It is calibrated in both degrees Fahrenheit and Centigrade. Power to operate the gage is supplied by the aircraft electrical power supply system, through a resistance type bulb which is located in the cabin air inlet duct at the nose of the fuselage. The outside air temperature circuit is protected by a push-to-reset circuit breaker (6, figure 1-20; 6, figure 1-21).

MAGNETIC COMPASS.

A magnetic compass (8, figure 1-24) is mounted just above the instrument panel on the windshield centerstrip where it can be easily read by the pilot and the copilot. The magnetic compass is illuminated for night operation by an integrally mounted compass light (refer to section IV, paragraph Magnetic Compass Light, for discussion of the compass light). A compass correction card (6, figure 1-24) is mounted just above the aircraft clock.

EMERGENCY EQUIPMENT.

WINDOW EMERGENCY RELEASE RING.

The left rear window on aircraft ▲ ▲ and the left center window on aircraft ▲ (figure 3-4) are provided as an emergency exit in that the entire window is jettisonable when the emergency release ring is pulled (see figure 3-4). The emergency release ring is mechanically connected to the window. The release ring is installed in a flush-mounted box on the left cabin wall below the window. The box contains a plexiglas cover drilled with a hole to facilitate its removal. The cover is marked EMERGENCY WINDOW RELEASE, PULL. The left rear window is marked EMERGENCY EXIT, PULL RING — PUSH WINDOW OUT.

FIRE EXTINGUISHER.

A hand-type fire extinguisher (figure 3-4) is mounted on a bracket installed just forward of the copilot's seat on the cabin floor.

FIRST AID KIT.

A first aid kit (1, figure 1-19, figure 3-4) is located on the right side of the utility shelf and is secured by four snap studs. This location is easily accessible to rear seat passengers as they need only to reach back and pull the kit from the shelf when an emergency arises.

AIR SICKNESS AND RELIEF CONTAINERS.

Six air-tight air sickness and relief containers are provided. The containers are stored in the large pocket provided on the back of the pilot's seat, and are easily accessible to any of the occupants of the aircraft.

CABIN DOOR.

A large non-jettisonable cabin door (26, figure 1-2) incorporating a fixed, acrylic plastic window, is provided on the right side of the aircraft for passenger entrance and exit. It is equipped with a key lock, a flush type door handle on the outside, a conventional type door handle on the inside, and a door stop. The key lock, located above the outside door handle, is operated by turning the key approximately 180 degrees. The key which operates the door lock also operates the baggage door lock.

EXTERIOR DOOR HANDLE.

A flush, pop-out type, exterior door handle (figure 1-26) is installed on the outside of the cabin door. The cabin door is opened from the outside by pushing on the aft end of the exterior door handle, pulling the handle out, and rotating it in a counterclockwise direction. The door handle should be returned to its recess after the door is opened. When closing the cabin door from the outside, the interior door handle should be first placed in the CLOSE position. The cabin door may then be pushed shut, and it will latch securely. The cabin door may be locked from the outside by grasping the exterior door handle in the usual manner, and rotating it clockwise to its stop (approximately 90 degrees), then returning it to its recess.

INTERIOR DOOR HANDLE.

The interior door handle (figure 1-27) located below the cabin door window near the forward edge of the door, has three positions marked LOCK, CLOSE, and OPEN. The cabin door is opened from inside the cabin by rotating the interior door handle clockwise to the OPEN position and pushing the door out until it engages the door stop provided at the bottom edge of the door. The cabin door may be closed from inside the cabin by placing the interior door handle in the CLOSE position, grasping the door arm rest, and pulling the door closed. The door may be locked from inside the cabin by first checking that the door is securely latched, then rotating the interior door handle in a counterclockwise direction to the LOCK position.

Note

Be sure the cabin door is securely locked before takeoff as it is very difficult and at times impossible to lock in flight.

PILOT'S AND COPILOT'S SEATS.

The pilot's and copilot's seats (figure 1-28) are individually mounted on tracks, and are adjustable fore and aft. They are also adjustable through three reclining positions. The seat backs fold forward to provide room for entrance to the passenger seat. Entrance to the pilot's seat may be made by stepping in behind the copilot's seat and forward through the aisle to the pilot's seat.

CAUTION

When the copilot position is not occupied, fold the backrest portion of the seat flat against the cushion and secure with the unused seat belt to prevent the backrest from jamming the controls during flight in turbulence.

Note

When loading the aircraft the pilot should enter first, rear seat passengers next and finally the copilot. Exit should be accomplished in reverse order.

On aircraft ▲ an arm rest is provided on the right side of the pilot's seat and left side of the copilot's seat and can be moved upward to the stowed position. Large pockets are provided on the backs of the pilot's and copilot's seats for stowage of maps, magazines and six air sickness and relief containers.

SEAT ADJUSTMENT HANDLES. ▲ ▲

The pilot's and copilot's seat adjustment handles (figure 1-28) are located on the front of the seats. The seats may be adjusted fore and aft by pulling up on the left handle on each seat and sliding the seat to the most comfortable position. Each seat may be adjusted to or from a reclining position by pulling up on the right handle and leaning backward or forward to the desired position. The seats may be locked by releasing the spring-loaded handles when the seat is in the selected position. It may be necessary to move the seat slightly, after releasing the handles, to allow the locking pins to latch securely.

SEAT ADJUSTMENT HANDLES. ▲

The pilot's and copilot's seat adjustment handles (figure 1-28) are located on the front and aft right side of each seat. The seats may be adjusted fore and aft by pulling up on the handle located in the front and sliding the seat to the most comfortable position. The seats may be locked by releasing the spring-loaded handle when the seat is in the selected position it may be necessary to move the seat slightly fore and aft after releasing the handle to allow the locking pins to latch securely. Each seat may be adjusted to or from a reclining position by leaning forward and rotating the handle on the aft right side to the desired position.

AUXILIARY EQUIPMENT.

Information concerning the following auxiliary equipment is supplied in Section IV: heating, ventilation and defrosting system, winterization kit, anti-icing and deicing systems, communications and associated electronic equipment, lighting equipment, gaseous oxygen supply system and miscellaneous equipment.

Section II. NORMAL PROCEDURES

Part 1. Mission Planning.

2-1. Mission Planning. Mission planning begins when the mission is assigned and extends to the preflight check of the aircraft. It includes, but is not limited to, checks of operating limits and restrictions; weight/balance and loading; performance; publications; flight plan and crew/passenger briefings. The pilot in command shall insure compliance with the contents of this manual that are applicable to the mission.

2-2. Operating Limits and Restrictions. The minimum, maximum, normal and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Section V, Operating Limitations, for detailed information.

2-3. Weight/Balance and Loading. The aircraft must be loaded, cargo and passengers secured, and weight and balance verified in accordance with TM 55-1510-216-23-4, Basic Weight Check List and Loading Data. This aircraft is in weight and balance class I and requires a weight and balance clearance when loaded in other than a normal manner in accordance with AR 95-16. The aircraft weight and center of gravity conditions must be within the limits prescribed in TM 55-1510-216-23-4, Basic Weight Check List and Loading Data.

2-4. Performance. Refer to Appendix I, PERFORMANCE DATA, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variations in loads, temperatures, and pressure altitudes. Record the data on the Takeoff and Landing Data Card for reference during takeoffs and landings.

2-5. Flight Plan. A flight plan shall be completed and filed in accordance with AR 95-1, DOD FLIP, and local regulations.

2-6. Crew/Passenger Briefings. A crew/passenger briefing shall be conducted to insure a thorough understanding of individual and team responsibilities. The briefing should include the copilot, crewchief, and ground crew responsibilities and the coordination necessary to completethe mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to OPERATING PROCEDURES AND MANEUVERS, Part III, Crew Duties, for suggested crew/passenger briefing.

Part II. Operating Procedures and Maneuvers.

2-7. Operating Procedures and Maneuvers.

a. This section deals with normal procedures and includes all steps necessary to insure safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

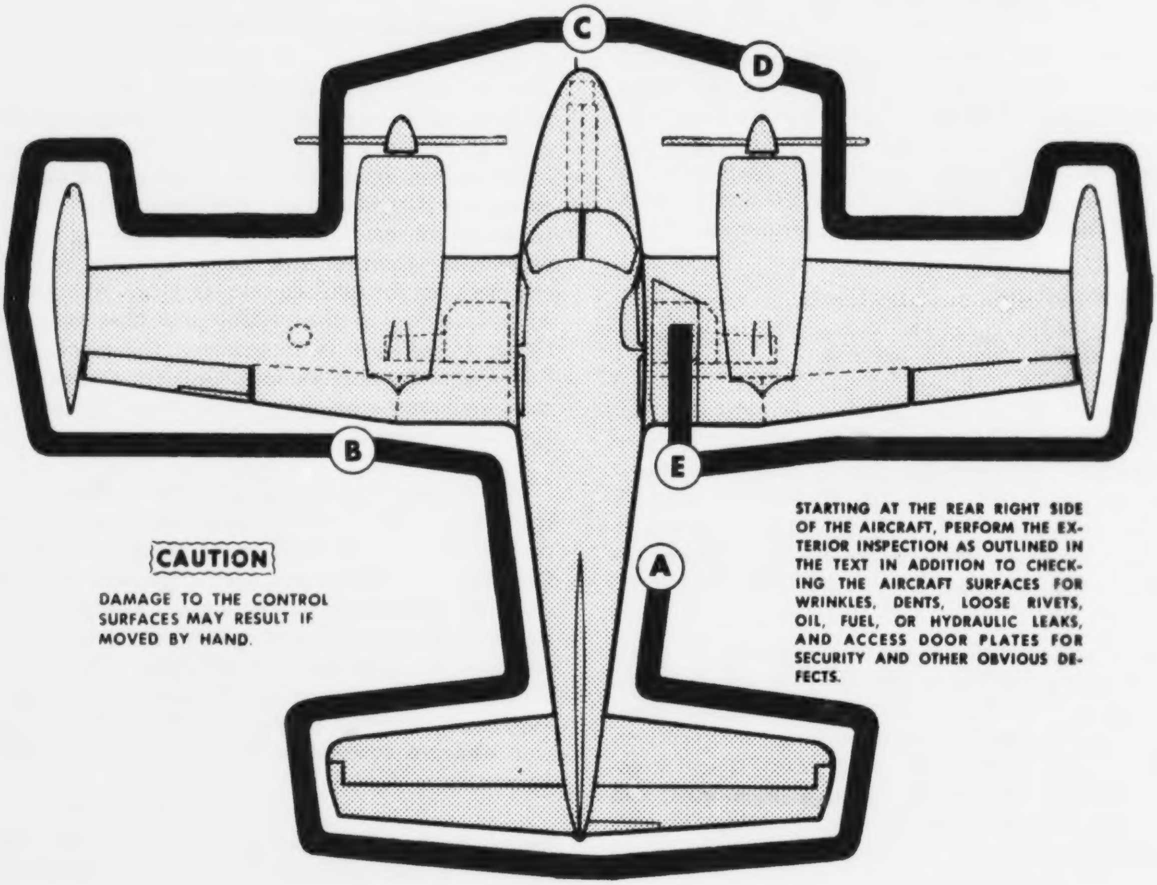
b. Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section VI, Flight Characteristics, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions supplement normal procedures checks in this section and are covered in Section IX, All Weather Operation.

2-8. Checks. The checklist includes items for day, night, and instrument flights with annotative indicators immediately preceding the check to which they are pertinent; (N) for night operations only; (I) for instrument operations only; (O) to indicate a requirement if the equipment is installed. The symbol ★ preceding steps of the checklist indicates that detailed procedures for those checks are included in the performance checks section located at the back of the condensed checklist (TM 55-1510-216-CL).

2-9. Thru-Flight Check. When an aircraft is flown by the same flight crew on a mission requiring intermediate stops it is not necessary to perform all of the normal checks. The steps that are essential for safe aircraft operation on intermediate stops are designated as "thru-flight" checks. An asterisk (*) indicates that performance of steps is mandatory for all "thru-flights" when there has been no change in crew. The asterisk applies only to checks performed prior to takeoff.

2-10. Checklist. Normal procedures are given primarily in checklist form and amplified as necessary only when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator's and Crewmember's Checklist, TM 55-1510-216-CL. To provide for easier cross referencing, the procedural steps are numbered to coincide with the corresponding numbered steps in this manual.

Exterior INSPECTION DIAGRAM



CAUTION

DAMAGE TO THE CONTROL SURFACES MAY RESULT IF MOVED BY HAND.

STARTING AT THE REAR RIGHT SIDE OF THE AIRCRAFT, PERFORM THE EXTERIOR INSPECTION AS OUTLINED IN THE TEXT IN ADDITION TO CHECKING THE AIRCRAFT SURFACES FOR WRINKLES, DENTS, LOOSE RIVETS, OIL, FUEL, OR HYDRAULIC LEAKS, AND ACCESS DOOR PLATES FOR SECURITY AND OTHER OBVIOUS DEFECTS.

Figure 2-1.

2-11. Checklist Callout. Pilots and crewmembers shall not rely on memory to verify prescribed operational checks except for those immediate action emergency procedures that must be memorized for safe aircraft emergency operation. These items are underlined. Oral callout and confirmation of checklist items shall be accomplished by pilot and crewmembers.

2-12. Preflight Check.

*a. **Before Exterior Check.*** Perform the following checks in accordance with figure 2-1.

*1. Publications - Check DD Form 1897, DA Form 2408-12, -13, -14, -18, and availability of Operator's Manual (-10), Checklist (-CL), DA Form 365F, and locally required forms and publications.

*2. Flight controls - Unlock.

*3. Parking brake - Set.

*4. Ignition switches - Off.

*5. Landing gear switch - DOWN.

6. Trim tabs - Set trim tabs to NEUTRAL except elevator trim set to TAKEOFF.

*7. Fuel selectors - MAIN.

8. Fire extinguisher - Check for security, servicing, seal, and general condition.

9. BATTERY SWITCH - ON.

10. Lighting systems - Check as required, to include all exterior lighting and left wing light (ice light).

11. Pitot heat - Check. Turn pitot heat switch ON and have ground crew check for operation.

12. Battery switch - Off.

*b. **Exterior Check.***

*Fuel samples - Check collective fuel sample from all drains for possible contamination and proper color.

(1) Fuselage Right Side.

1. General condition - Check for skin damage, buckling, distortion, or dents.

2. Oxygen fill access - Secured.

3. Static port - Check free of obstruction.

4. Antennas - Check for security and general condition.

(2) Empennage.

(O) 1. Deicer boot (right side) - Check for bonding, cracks, loose patches, and general condition.

2. Right horizontal stabilizer - Check for skin damage, buckling, splitting, distortion, and dents.

3. Right elevator and trim tab - Check security, hinge attachment, and trim tag rig.

(O) *4. Rudder surface lock - Remove.

*5. Tiedown - Remove.

6. Position light - Check for condition.

7. Rudder and trim tab - Check security, hinge attachment, and trim tab rig.

8. Vertical stabilizer - Check for skin damage, distortion, and dents.

9. Left elevator - Check security and hinge attachment.

10. Left horizontal stabilizer - Check for skin damage, buckling, splitting, distortion, and dents.

(O) 11. Deicer boot (left side) - Check for bonding, cracks, loose patches, and general condition.

(3) Fuselage Left Side.

1. General condition - Check for skin damage, buckling, distortion, or dents, and antennae secure.

2. Rotating beacon - Check for condition.

3. Static port - Check free of obstruction.

(4) Left Wing.

1. General condition - Check for skin damage, buckling, crackling, splitting, distortion, and dents.

2. Wing flap - Check for full retraction (3/8 inch maximum play), skin damage, buckling, distortion, or dents.

3. Aileron and trim tab - Check security and trim tab rig.

*4. Main fuel tank - Check fuel level, seal installed, cap tight and aligned, and check for vented cap.

5. Navigation light - Check for condition.

(O) 6. Mirror - Check for condition.

*7. Tiedown - Removed.

8. Stall warn ing vane - Check.

*9. Aux fuel tank - Check fuel level, seal installed, cap tight and aligned; check for unvented cap.

NOTE

Insure main tank is fitted with a vented filler cap and aux tank is fitted with a non-vented filler cap.

(O) 10. Deicer boot - Check for bonding, cracks, loose patches, and general condition.

(5) Left Main Gear.

*1. Chocks - As required.

2. Tire - Check for condition and proper inflation.

3. Brake assembly - Check brake lines for damage and for signs of leaks, check disc for warpage and condition.

4. Shock strut - Check for leakage, condition, and proper extension (2 inches minimum).

5. Safety switch - Check for condition and security. Do not press switch plunger.

(O) *6. Ground lock - Removed.

7. Wheel well condition - Check for general condition.

8. Doors and linkage - Check for condition, security and alignment.

(6) Left Engine and Prop.

1. Accessory section - Check for leaks and general condition, check generator belt condition and tension.

*2. Oil quantity - Check oil level and dipstick locked (11 qt. minimum).

NOTE

Oil syphoning will occur if the oil dipstick or oil filler cap are not locked in place.

*3. Access door - Secure.

4. Cowling and door - Secure.

*5. Oil filler cap and cover - Check secure.

(O) 6. Winterization baffles - Secure.

NOTE

Baffles should be installed if FAT is below -7°C. (20°F.).

7. Prop blades and spinner - Check blades for condition and security, spinner and anti-icing parts for security and freedom from obstruction.

8. Oil cooler - Check for freedom from obstruction and leaks.

9. Cowling and access doors - Secure.

(7) Fuselage Underside.

1. Skin condition - Check.

2. Antennas - Check general condition.

(8) Nose Section.

1. Wheel well condition - Check.

2. Doors and linkage - Check the nose gear actuating arm for security before first flight of the day or after known maintenance in this area.

3. Tire - Check condition and proper inflation.

4. Shock strut - Check for leakage, condition, and proper extension (2 inches minimum).

5. Taxi light - Check security and condition.

6. Shimmy damper - Check condition and attaching linkage.

(O) *7. Ground lock - Removed.

8. Glide slope antenna - Check security and general condition.

9. Heater air intake - Clear.

*10. Pitot tube - Check cover removed and check alignment, security, and freedom from obstruction.

11. Windshield - Check for cracks, crazing and cleanliness.

(9) Right Engine and Prop.

1. Accessory section - Check for leaks and general condition.

*2. Oil quantity - Check oil level and dipstick locked (11 qt. minimum).

NOTE

Oil syphoning will occur if the oil dipstick or oil filler cap are not locked in place.

*3. Access door - Secure.

4. Cowling and door - Secure.

*5. Oil filler cap and cover - Check secure.

(O) 6. Winterization baffles - Secure.

NOTE

Baffles should be installed if FAT is below -7°C. (20°F.).

7. Prop blades and spinner - Check blades for condition and security, spinner and anti-icing parts for security and freedom from obstruction.

8. Oil cooler - Check condition.

9. Cowling and access doors - Secure.

(10) Right Main Gear.

*1. Chocks - As required.

2. Tire - Check for condition and proper inflation.

3. Brake assembly - Check brake lines for damage and for signs of leaks. Check disc for warpage and condition.

4. Shock strut - Check for leakage, condition and proper extension (2 inches minimum).

(O) *5. Ground lock - Removed.

6. Wheel well condition - Check for general conditions.

7. Doors and linkage - Check for condition, security and alignment.

(11) Right Wing.

*1. Aux fuel tank - Check fuel level, seal, installed, cap tight and aligned, and check for non-vented cap.

2. Landing light - Check for condition.

*3. Tiedown - Remove.

(O) 4. Deicer boot - Check for bonding, cracks, loose patches, and general condition.

5. Navigation light - Check for condition.

*6. Main fuel tank - Check fuel level, seal installed, cap tight and aligned, and check for vented cap.

NOTE

Insure main tank is fitted with a vented filler cap and aux tank is fitted with a non-vented filler cap.

7. Aileron - Check security and hinge attachment.

8. Wing flap - Check for full retraction (3/8 inch maximum play), skin damage, buckling, distortion, or dents.

9. General condition - Check for skin damage, buckling, cracking, splitting, distortion and dents.

(12) Baggage Compartment and Cabin Door Area.

*1. Equipment - Secure.

(O) 2. Oxygen control valve - As required.

*3. Baggage door - Closed, latch secure.

4. Fuselage upper section - Check for general condition.

c. *Interior Check.*

1. Rear passenger seat - Latch secure.

2. First-aid kit - Check for security, current inspection data.

3. Cabin emergency exit latch - Check ring in place and window secure.

4. Loose equipment - Secure.

★ 5. Personnel/crew briefing - As required (Refer to Crew Duties, Part III in this Section.)

2-13. Before Starting Engines.

*1. Seats, belts, harness - Adjusted. Check seat firmly to assure that the locking pin is latched securely.

NOTE

When copilot seat is not occupied, secure backrest with seat belt or shoulder harness to prevent backrest from jamming controls during turbulence.

2. Overhead console panel - Check and set.

3. Magnetic compass - Check fluid, compass card current.

*4. Throttle - Set open approximately 1/2 inch.

*5. Propeller levers - INCREASE.

*6. Mixtures - Full rich.

7. Carb/ind air - COLD/OFF and locked.

8. Gear emergency handcrank - Stowed.

9. Circuit breaker panels - Check.

10. Static pressure alternate source - Closed (Forward).

NOTE

Do not use alternate static source during takeoff and landing except in an emergency. Variations in airspeed and altitude will occur.

11. Generators - ON.

12. Boost pumps - Off.

13. De-icing controls - Off.

14. Interior lights - As required.

15. Cabin heat - OFF.

16. Pitot heat - OFF.

17. Navigation lights - Off.

18. Taxi and landing lights - Off.

19. Pilots flight instruments - Check instruments for protective glass, limitations markings, and static readings.

20. Radios - OFF.

21. Engine instruments - Check instruments for protective glass, limitations markings, and static readings.

22. Temperature controls - OFF.

(O) 23. Prop anti-ice controls - OFF.

2-14. *Starting Engines.

1. GPU/Battery - ON.

NOTE

Battery switch off when GPU is connected.

(N) 2. Navigation lights - ON.

3. Warning and indicator lights - Check.

4. Fuel quantity gauges - Check quantity in main and auxiliary tanks.

a. ***First Engine Start (U-3A Only).***

NOTE
Left engine should be started first.

1. Rotating beacon - ON.

2. Propellers - Clear.

3. Ignition switches - ON.

4. Boost pump - ON.

NOTE
Do not leave mixture lever in FULL RICH with boost pump ON for extended time with engine inoperative. Flooding will occur.

CAUTION
Allow 5 minutes cooling time after starter engagement of 30 seconds.

5. Starter button - Press release after engine fires.

6. Prime - As required.

7. Throttle - Set (800-1000 RPM)

CAUTION
An oil pressure indication should appear within 30 seconds in normal weather; 60 seconds in cold weather. If no oil pressure indication appears, shut down engine and advise maintenance personnel.

8. Oil pressure - Check.

9. Boost pump - Off.

10. Mixture - Lean. Retard mixture lever until slight engine roughness is detected, then advance lever two to four notches.

b. ***Second Engine Start (U-3A only).***

1. Propeller - Clear.

2. Ignition switches - ON.

NOTE
Do not leave mixture lever in FULL RICH with boost pump ON for extended time with engine inoperative. Flooding will occur.

3. Boost pump - ON.

CAUTION
Allow 5 minutes cooling time after starter engagement of 30 seconds.

4. Starter button - Press. Release after engine fires.

5. Prime - As required.

6. Throttle - Set (800-1000 RPM).

CAUTION
Oil pressure indicator should appear within 30 seconds in normal weather; 60 seconds in cold weather. If no oil pressure indication appears, shut down engine and advise maintenance personnel.

7. Oil pressure - Check.

8. Boost pump - Off.

9. Mixture - Lean.

NOTE
To find the lean position, retard mixture lever until slight engine roughness is detected, then advance two to four notches.

10. GPU disconnect - As required.

11. Battery on - As required.

c. ***Engine Clearing (Flooded engine) (U-3A only).***

1. Mixture - ICO.

2. Boost pumps - Off.

3. Throttle - One half to full open.

4. Starter button - Press. Release after engine fires.

5. Mixture - FULL RICH (after engine starts).

CAUTION

Adjust throttles not to exceed 1000 RPM until a definite rise in cylinder head temperature is indicated.

6. Throttles - Set (800-1000 RPM).

2-15. Engine Ground Operation. Warm up engine at 800-1000 RPM until oil pressure and all temperatures show a definite increase. Once engine is warm, maintain a minimum of 1400 RPM except when taxiing. To prevent spark plug fouling, lean each engine with the mixture control.

2-16. Before Taxiing.

***1.** Radios - ON.

***2.** Mixture levers - Lean.

3. Fuel selectors - Check fuel selector valve handles for operation in all detents to determine proper operations. Start check by placing selector handle in OFF position and observing fuel flow/pressure gage. As soon as a decrease is noted on gage, move the selector to the opposite MAIN tank position. Leave in opposite MAIN tank position for a sufficient period of time to determine fuel flow. Repeat the check in the AUXILIARY position and then set handle to MAIN for takeoff.

CAUTION

Carburetor air knobs (U-3A) or induction air handles (U-3B) should not be placed in intermediate positions.

(O) 4. Carb air/ind air - As required. During cold weather use HEAT, as necessary, for smooth engine operation.

5. Throttles - Set (1400 RPM).

6. Radios - Check.

***7.** Taxi clearance - Received.

8. Clock - Set and operating.

***9.** Altimeter - Set at field barometric pressure and within limits (± 75 ft).

10. Landing/taxi lights - As required.

***11.** Chocks - Check removed.

2-17. *Taxiing. Nose wheel steering is preferred whenever practical for steering of the aircraft. Steering may be supplemented with the rudder, differential power, and differential braking on the main wheels. Refer to figure 2-2 for minimum turning radius. When stopped, maintain 1400 RPM. While taxiing perform the following checks.

1. Brakes - Check.

2. Flight instruments - Check.

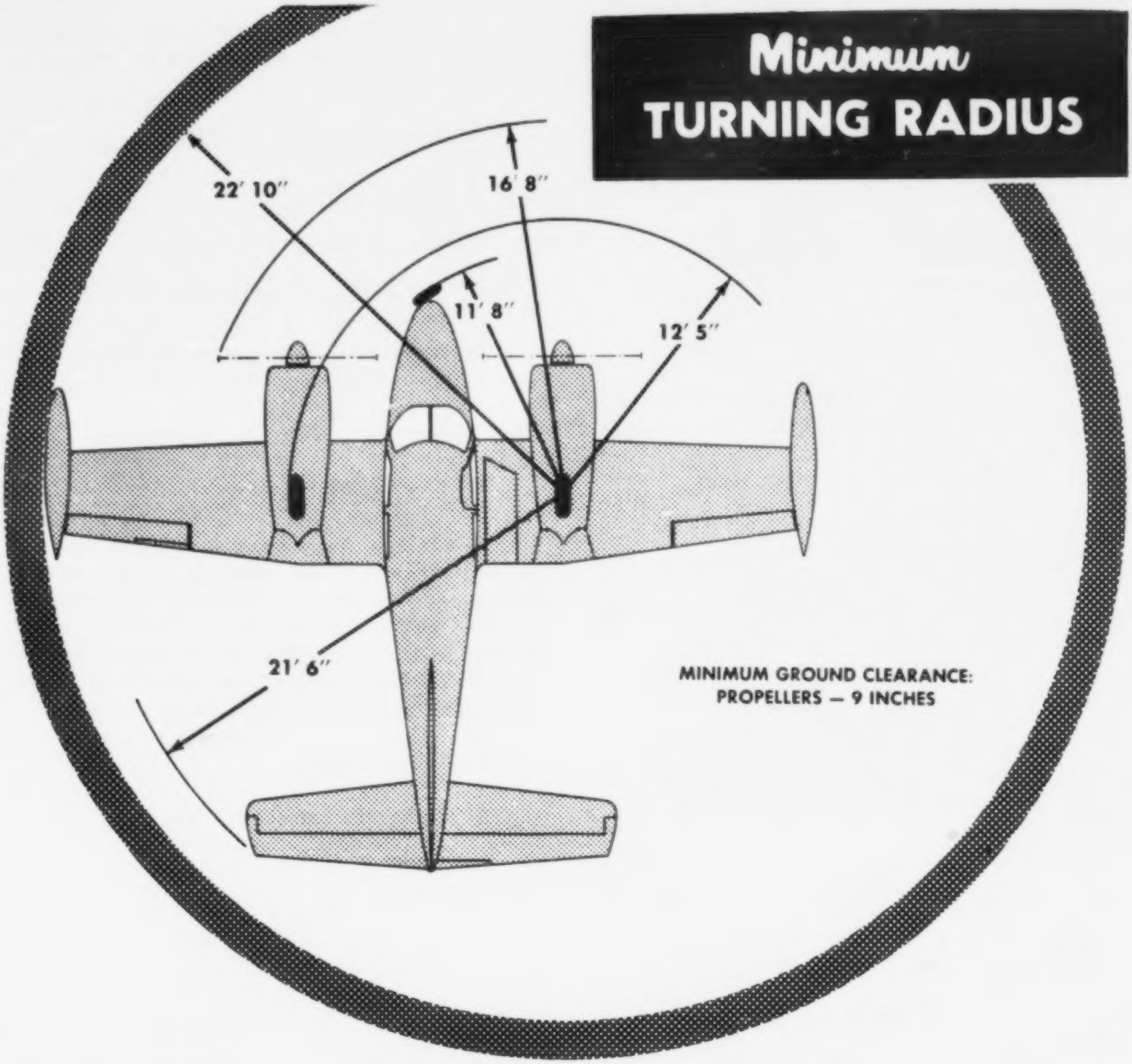


Figure 2-2.

2-18. *Engine Run-Up.

1. Nose wheel - Center

2. Parking brake - Set.

3. Ignition groundout - Check. At idle speed, turn ignition switches off, one at a time, momentarily, then ON. Check that each engine operates on each individual magneto. Turn all four switches OFF at the same time momentarily, then ON. Check that each engine ceases firing.

4. Throttles - Set (1400 RPM).

5. Wing flaps - Check for full travel and operation of position indicator.

6. Engine instruments - Check that pressures, and temperatures are within operating limits.

7. Mixtures - FULL RICH.

8. Throttles -1700 RPM.

9. Generator operation - Check each generator individually by turning the opposite generator OFF. Note slight change from the generator that is operating.

10. Ignition system - Check. Maximum difference between individual magnetos should not exceed 50 RPM. Maximum allowable drop on each magneto is 125 RPM (U3A) or 150 RPM (U3B).

NOTE

If a magneto exceeds max allowable drop, run engine to 1700 RPM with mixture rich, lean engine until 50 RPM increase is noted, then advance to 2000 RPM for one minute. Retard throttle to 1700 RPM, mixture to FULL RICH, and reaccomplish ignition check.

11. Vacuum - Check that reading is 4.75 to 5.25 hg. Push knob in and select L. source and R. source. Readings should indicate higher than the normal instrument readings.

★ **12.** Propeller governors - Check operation.

(a) Retard the propeller levers back beyond the detent to FEATHER until engine speed drops to 1000 RPM, then advance the propeller levers to full INCREASE RPM, (in cold weather, repeat the procedure two or three times).

(b) When propeller operation is unusually sluggish or erratic, feather propeller twice to 600 RPM momentarily. Exercising the propeller in this manner insures optimum propeller governor operation in flight.

(O) **13.** Carb air/ind air - Check by pulling the knobs or handles full out position, noting RPM and manifold pressure drop, then return the knobs or handles to the full in position and lock.

14. Throttles - Set (1400 RPM).

15. Mixture - Lean.

★ **(I)(O) 16.** Deicing system - Check.

(a) Deicing charge knob - PULL ON.

(b) Deicing cycle gage - Check. The cycle gage should read approximately 148 cycles remaining, indicating the tank is full. Refer to Deicing System, Section IV.

NOTE

The cycle gage indicates the number of cycles remaining only when the charge knob is in the PULL ON position.

(c) Deicing cycle knob - PUSH ON. Check the inflation and deflation of the boots. The cycle knob should pop out as deflation begins, and the deflation should be rapid.

(d) Deicing charge knob - PUSH OFF.

2-19. *Before Takeoff.

1. Propellers - INCREASE RPM.

2. Mixtures - As required.

3. Flaps - As required.

4. Trim - Set.

(O) **5.** Carb Air/Ind Air - COLD/Air.

6. Fuel selectors - MAIN, check detent.

NOTE

Due to linkage between selector handle in cockpit and valve in nacelle, a certain amount of "feel" will have to be acquired to insure the valve is positioned in the detent. Merely placing the selector handle to MAIN will not always insure the valve is in the detent.

7. Boost pumps - ON. Check pressure fluctuation to insure pump operation.

8. Fuel quantity - Check.

9. Flight and engine instruments - Check for proper indications.

10. Navigation radios - Set.

11. Flight controls - Check for full travel and that movement corresponds to control surface movement.

12. Takeoff clearance - Received.

13. Doors and windows - Locked.

14. Anti-ice/de-ice/pitot heat - As required.

(O) **15.** Strobe light - ON.

2-20. *Line Up.

1. Transponder - As required.

2. Directional gyro - Set. Rotate the setting knob to assure that the gyro is uncaged.

3. Mixture - As required. Set at FULL RICH for U-3A. For U-3B, set on low fuel flow side of the takeoff and climb range for applicable takeoff.

2-21. Takeoff. To aid in planning the takeoff and to attain the maximum performance possible, make full use of all the information affecting takeoff which is furnished in Appendix I of this manual. Normal takeoff is made with flaps up. Since full throttle is not recommended during the static run-up check (other than to set takeoff mixture at altitude), it is important to observe full throttle engine operation, early in the takeoff run. Any signs of rough engine operation, unequal power between engines, sluggish engine acceleration, or RPM/manifold pressure below pre-computed value is cause for discontinuing the takeoff. If this occurs, the pilot is justified in making a thorough, full throttle, static run-up check before another takeoff is attempted. The recommended lift-off speed (Vlof) for a normal takeoff is 95 mph. Recommended rotation speed (Vr) for all takeoffs is approximately 3 mph below Vlof. To maintain a safe margin over single engine minimum control speed (Vmc) and single engine stall speed (Vsi), it is recommended that the aircraft not be flown from the runway until this speed (safe single-engine speed) is reached. If runway lengths do not permit this procedure, follow the minimum run takeoff procedures. When flight is assured, retract the landing gear and establish the attitude to obtain best rate of climb speed (Vy). At single engine maneuvering altitude (not less than 500 feet AGL), adjust pitch to obtain cruise climb airspeed. Adjust power (throttle and propeller) to climb power setting and set mixture as required for altitude. Complete "after take off checks".

WARNING

Minimum run takeoff and obstacle clearance climb described below are contingency maneuvers and are performed below Vmc and below power off stall speed. Control of the aircraft will be lost if engine failure occurs at or immediately following liftoff until a safe speed can be attained. These maneuvers should be performed only in an emergency.

2-22. Minimum Run Takeoff. Minimum run takeoffs are performed with 15° flaps. After the LINEUP CHECK is completed, hold the brakes firmly and slowly advance the throttles to maximum manifold pressure. Release brakes and maintain directional control with rudders. Rotate so as to become airborne at the prescribed airspeed for maximum performance takeoff. After the aircraft breaks ground, lower the nose slightly to accelerate to safe single-engine speed. When flight is assured, retract the landing gear and establish initial climb attitude. After safe single-engine speed is attained, retract wing flaps and adjust attitude to attain best rate-of-climb speed (Vy).

2-23. Obstacle Clearance Climb. Follow procedures outlined above for minimum run takeoff to the point of actual liftoff. When flight is assured, retract the landing gear and establish the attitude to obtain best angle-of-climb speed (Vx). Retract flaps after clearing obstacles, then lower the nose and accelerate to best rate-of-climb speed (Vy).

2-24. Crosswind Takeoff. At the beginning of the takeoff roll, apply upwind aileron, as necessary, to assist in maintaining directional control. The nosewheel should stay on the runway until rotation speed (Vr) is reached. At this time, rotate so that positive liftoff is obtained at liftoff speed (Vlof). This will avoid side-skipping as weight is lifted from the landing gear. Initial drift correction is made by turning into the wind with a shallow bank, then rolling the wings level to establish a "crab". Continue to climb straight ahead maintaining required drift correction.

2-25. After Takeoff.

1. Landing gear - UP.

NOTE

On some U-3A aircraft, the landing gear position light automatically dims when navigation lights are ON. In this case turn NAV LT switch off momentarily to check gear position light.

2. Flaps - UP.

3. Power - Set.

4. Landing/Taxi lights - Retract/Off.

5. Boost pumps - Off. Individually check fuel pressure as pumps are turned off.

6. Wing inspection - Complete. Check for oil or fuel leaks.

2-26. Climb. Recommended cruise climb speed is 130 MPH at approximately 75% power (24 hg and 2450 RPM). Monitor engine instruments during extended climbs. Engine roughness may occur in climb at altitudes above 5000 feet with mixture full rich. Gradual leaning to eliminate roughness as altitude is increased should be applied. The mixture should be leaned to give fuel flow on the high fuel flow side of the cruise power dial range (75% cruise power setting on flowmeter dial) which is approximately best power mixture.

NOTE

The fuel flow settings on the takeoff and climb power segment of the dial are for 2625 RPM and full throttle only. Climb power settings at RPM lower than 2450 should be taken from the power schedule tables and mixture adjusted to the low fuel flow side of the cruise power range.

2-27. Cruise.

1. Cruise power - Set. Refer to data in Appendix I.

2. Mixture - As required. Lean the mixture in accordance with the procedures in Section VII.

3. Fuel selectors - As required.

NOTE

Fuel should be used from the main tanks during starting, warm-up, takeoff, and during flight for 60 minutes prior to using fuel from the auxiliary tanks. Fuel may then be used from the auxiliary tanks.

2-28. Descent - Max Rate (Clean).

1. Mixture - Set.

2. Throttles - As required.

NOTE

Maintain manifold pressure within green arc during descent.

3. Propellers - INCREASE RPM.

4. Landing gear - UP.

5. Flaps - UP.

6. Airspeed - 248 MPH. ▲1 ▲2 ▲4
252 MPH. ▲3

2-29. Descent - Max Rate/Angle (Landing Configuration).

1. Mixture - Set.

2. Throttles - As required.

NOTE

Maintain manifold pressure within green arc during descent.

3. Propellers - INCREASE RPM.

4. Flaps - 15° (below 160 MPH).

5. Landing gear - DOWN (below 140 MPH).

6. Flaps - Full DOWN (below 140 MPH).

7. Airspeed - 140 MPH.

NOTE

The airspeed for traffic pattern is 130 MPH until abeam the touchdown point on downwind leg.

2-30. Descent-Arrival.

1. Passengers - Alerted.

2. Seat belts/shoulder harness - Secure.

3. Mixtures - As required.

4. Fuel Selectors - MAIN.

2-31. Before Landing.

1. Boost pumps - ON.

2. Propellers - 2450 RPM.

3. Flaps - 15° (below 160 MPH).

4. Landing gear - DOWN (below 140 MPH).

5. Landing lights - Extend/On (below 140 MPH).

2-32. Landing Check.

1. Landing gear - Recheck DOWN.
2. Propellers - INCREASE RPM.

2-33. Landing - Normal Landing. When established on final approach and when landing flaps are extended, stabilize airspeed to 1.3 x power-off stall speed (Vso) plus wind gust spread (see Appendix I). Complete "Landing check" and coordinate pitch and power to control airspeed, rate of descent, and to obtain a smooth transition from approach to landing altitude. Start flare out so as to touchdown on main gear as power is smoothly reduced to idle. Plan to touchdown just as stalling speed is reached. After ground contact, as the aircraft slows down, lower the nosewheel gently to the runway, losing as much speed as practicable before using brakes. Braking will be more effective when weight of the aircraft settles on the landing gear. Immediately after landing or at any time when there is lift on the wings, care should be taken to avoid skidding the tires. For short landing roll, a single, smooth application of the brakes with constantly increasing pressure is most desirable.

2-34. Minimum Run Landing. Minimum run landings are performed with the wing flaps extended to 45°. Adjust pitch and trim to maintain airspeed (1.2 x poweroff stall speed in landing configuration (Vso)) and descent angle. Plan for a slightly longer final approach leg to allow more time for approach angle corrections. Maintain a constant line of descent and desired airspeed by using proper pitch and power coordination. Transition smoothly from approach to landing attitude. Touchdown on the main gear with the nose slightly high, and with as much power as possible. Immediately after touchdown, allow the nosewheel to make ground contact, reduce power to idle, and apply maximum braking. Care should be taken to avoid skidding the tires.

2-35. Go-Around. The decision to go-around should be made as early as possible to provide a safe margin of airspeed and altitude. Accuracy, judgment, and early recognition of the need to go-around are important. Control forces due to elevator trim and flap settings may create heavy elevator pressures. Establish shallow climb and trim off pressures as soon as possible. If conditions preclude landing touch-down, perform the following procedures:

1. Power - As required. Use maximum allowable below 300 ft AGL.
2. Landing gear (descent stopped) - UP.
3. Wing flaps - Initially 15°.
4. Carb air/ind air - As required.
5. Flaps - UP (95 MPH).
6. Landing lights - As required.

2-36. After Landing. Complete the following procedures:

1. Boost pumps - OFF.
2. Wing flaps - UP.
3. Mixtures - Lean.

(O) 4. Carb heat/Ind air - As required.

5. Radios, Transponder - As required.
6. Landing and taxi lights - As required.
7. Anti-ice/de-ice/pitot heat - As required.
8. Cabin heater - OFF.

(O) 9. Strobe light - OFF.

2-37. Engine Shutdown.

1. Parking brake - Set.
2. Radios - OFF.
3. Oil dilution - As required.
4. Throttles - Set (800 RPM).
5. Ignition groundout - Check. Turn all fou switches OFF momentarily, then ON. Check tha each engine ceases firing.
6. Mixtures - ICO.

NOTE
Do not open throttles as engines stop.

7. Ignition switches - OFF (after engines stop).

8. Exterior lights - OFF.

9. Battery - OFF (Leave battery switch ON until heater fan shuts off).

10. Fuel selector - OFF.

2-38. Before Leaving Aircraft.

1. Chocks - Installed.

2. Walk around inspection - Completed.

3. Parking brake - As required.

4. Flight controls - Locked.

5. DA Form 2408-12-13 - Completed

NOTE

In addition to established requirements for reporting any system defects, unusual and excessive operation such as hard landings, etc., the flight crew will also make entries on DA Form 2408-13 to indicate when limits in the Operator's Manual have been exceeded.

6. Windows and doors - As required.

7. Pitot cover - Installed.

(O) 8. Rudder lock - Installed.

(O) 9. Ground locks - Installed.

10. Aircraft - Secured.

Part III. Crew Duties

2-39. Passenger Briefing. The following is a guide that should be used inaccomplishing required passenger briefings when a unit passenger briefing is not available. Items that do not pertain to a specific mission may be omitted.

a. Crew Introduction.

b. Equipment.

(1) Personal to include ID tags.

(2) Professional.

(3) Survival.

c. Flight Data.

(1) Route.

(2) Altitude.

(3) Time en route.

(4) Weather.

d. Normal Procedures.

(1) Entry and exit of aircraft.

(2) Seating.

(3) Seat belts.

(4) Movement in traffic.

(5) Internal communications.

(6) Security of equipment.

(7) Smoking.

(8) Oxygen.

(9) Refueling.

(10) Weapons.

(11) Protective masks.

(12) Parachutes.

e. Emergency Procedures.

(1) Emergency exits.

(2) Emergency equipment.

(3) Emergency landing/ditching procedures.

(4) Bail out.

PERFORMANCE PLANNING CARD

TAKEOFF AND LANDING DATA

CONDITIONS

Pressure Altitude ________ FT
Temperature ________ °C
Wind Direction ________ Velocity ________ KT
RWY: Heading _____ Length _____ Slope ________ %U/D
Gross Wt (Takeoff) ________ LB
Gross Wt (Landing) ________ LB

TAKEOFF DATA

Takeoff Power: _____ RPM ________ MP
Takeoff Fuel Flow (U-3B) ________ GPH
Takeoff Ground Run ________ FT
Acc/Stop Distance ________ FT
Minimum Control Speed (Vmc) ________ MPH
Power-Off Stall Speed (Vsi) ________ MPH
Rotation Speed (Vr) ________ MPH
Lift off Speed (Vlof) ________ MPH
Best Angle of Climb Speed (Vx) ________ MPH
Best Rate of Climb Speed (Vy) ________ MPH
S/E Best Rate of Climb Speed (Vyse) ________ MPH
S/E Rate of Climb (Gear Up) ________ FPM

LANDING IMMEDIATELY AFTER TAKEOFF

Final Approach Speed ________ MPH
Landing Ground Roll ________ FT

LANDING AFTER MISSION

Final Approach Speed ________ MPH
Landing Ground Roll ________ FT

Section III. EMERGENCY PROCEDURES

Part 1. Aircraft System Emergencies.

3-1. General. This section describes the aircraft systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the Operator's and Crewmember's Checklist, TM 55-1510-216-CL.

3-2. Immediate Action Emergency Checks. Those checks that must be performed immediately in an emergency procedure are underlined and shall be committed to memory.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control. All procedures are subordinate to this requirement.

3-3. Emergency Exits and Equipment. The main cabin entrance door (not jettisonable) is used for normal or emergency exit. A removable window on the left side of the fuselage is used for emergency exit only. The main cabin entrance door and the left rear window provide emergency escape routes from the aircraft either on the ground or when ditching. Figure 3-1 shows the emergency escape routes and the location of emergency exits.

3-4. Emergency Entrance. Emergency entrance into the cabin area may be gained through the cabin door and baggage compartment door. If the doors are jammed, entrance may be gained by kicking in any of the cabin windows. (Figure 3-1).

3-5. Flight Characteristics Under Partial Power Conditions.

a. With the proper understanding of single-engine procedures and single engine flight principles, the aircraft can be flown and landed safely with one engine inoperative. The unbalanced engine thrust, which has a tendency to yaw the aircraft into the dead engine, must be neutralized by holding rudder and aileron or by trimming to offset the necessary amount of rudder. Rudder deflection required to maintain directional control may be reduced by banking the aircraft approximately five degrees into the good engine. More rudder deflection is necessary to counteract the unbalanced thrust as airspeed is decreased. When airspeed has decreased to the point where full rudder is needed to maintain directional control, any further reduction of airspeed will result in loss of directional control. The slowest airspeed at which a safe margin of control may be maintained over the maximum unbalanced thrust of the operating engine is the safe single-speed airspeed.

b. The slowest speed (single engine minimum control speed Vmc) which will provide adequate directional control at gross weight, in takeoff configuration, at sea level, standard day temperature, critical engine propeller windmilling, and maximum power on the operative engine is 80 MPH IAS for U-3A aircraft and 88 MPH IAS for U-3B aircraft. However, the aircraft will not maintain altitude in this configuration under any condition. Consequently, sufficient altitude must be available to permit retracting the landing gear and feathering the propeller of the inoperative engine if single-engine flight is to be continued.

c. Since directional control and aircraft performance are very marginal at the minimum control speed, continued single-engine flight should be considered inadvisable if the airspeed is below the minimum safe single-engine speed (best single-engine rate of climb) of 95 MPH IAS. This speed will provide directional control and over 100 ft./min. rate of climb at gross weight on a standard day at sea level after the landing gear is retracted and the propeller of the inoperative engine is feathered.

d. Although the performance will decrease with increasing temperatures and altitudes, this speed will permit a reasonably safe single engine climb should an engine fail immediately after takeoff at field elevations up to 4,000 feet, since airspeed (down to Vmc or single engine stall speed) can be sacrificed to maintain altitude while the landing gear is being retracted and the inoperative propeller is being feathered. Should the wing flaps be extended, they should be retracted in small increments as airspeed and altitude permit.

EMERGENCY EXITS, ENTRANCES and Equipment

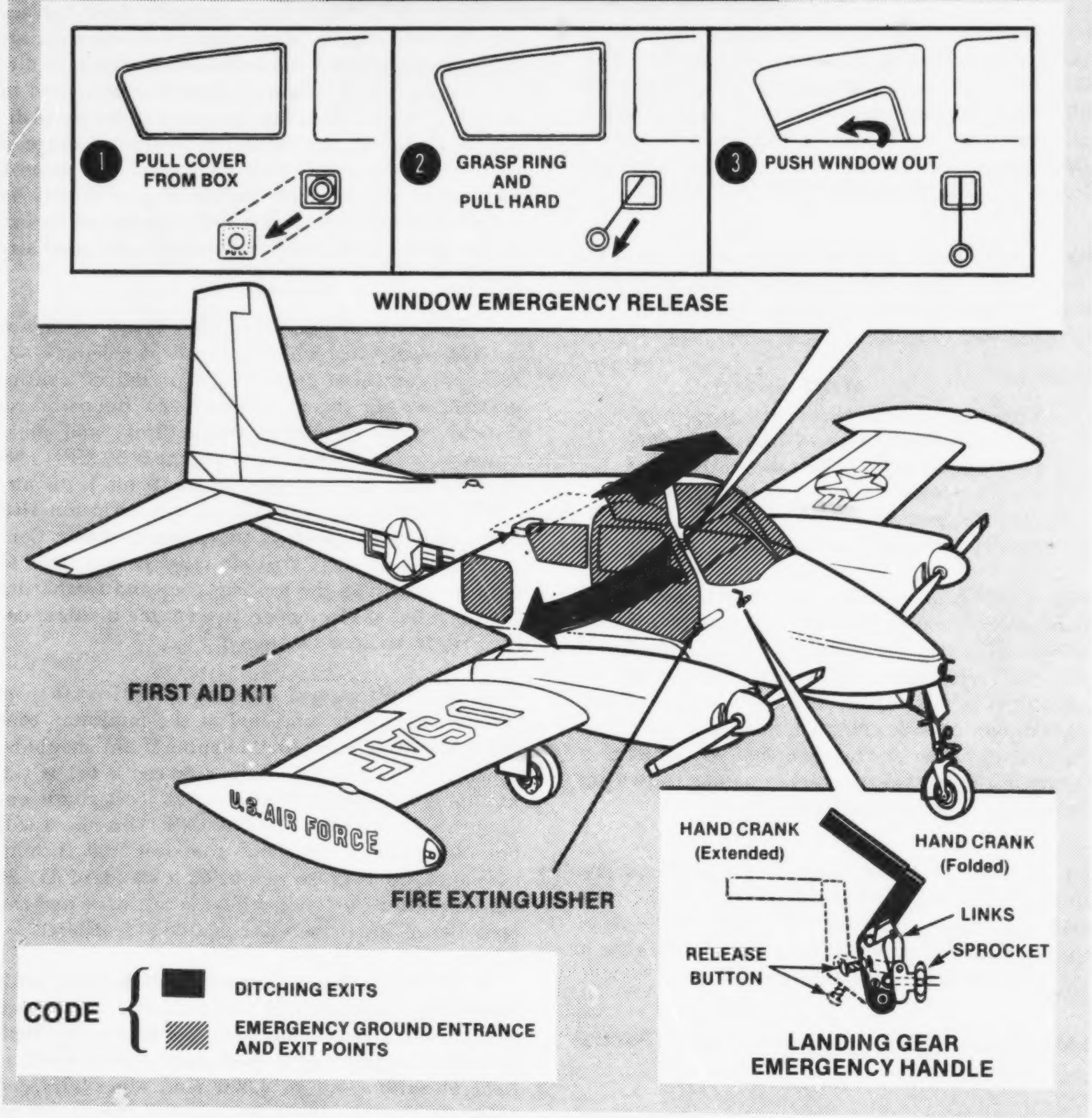


Figure 3-1

3-6. Engine Malfunction Under Specific Conditions.

a. During Takeoff Run (Abort).

1. Throttles - Idle.

2. Braking - As required.

b. After Takeoff (below VMC). If a minimum run takeoff has been started and Vmc has not been reached prior to engine malfunction, proceed as follows:

1. Power - Reduce (maintain directional control).

2. Land - Straight ahead. Make shallow turns to avoid obstacles as required.

c. After Takeoff (Takeoff Cont'd).

1. Power - As required.

2. Dead engine - Identify.

3. Throttle (dead engine) - Closed.

4. Prop (dead engine) - FEATHER.

5. Gear - Up.

6. Flaps - Up (slowly).

7. Airspeed - Single engine best rate of climb (Vyse).

8. Climb Power - Set.

9. Landing/Taxi Lights - Retract/Off.

10. Boost Pumps - OFF.

11. Wing Inspection - Complete.

d. During Flight.

1. Power - As required.

2. Dead Engine - Identify.

3. Throttle (dead engine) - CLOSED.

4. Prop (dead engine) - FEATHER.

5. Gear - UP.

6. Flap - UP.

7. Power - As required.

NOTE

The landing gear horn will sound as soon as the throttle is closed. The horn may be silenced by opening the throttle slightly after the engine has been completely shut down.

e. During Final Approach. If an engine malfunctions during short final the prop should not be feathered unless conditions require it. Continue approach using the following procedures.

1. Power - As required.

2. Gear - Recheck DOWN.

f. Engine Restart During Flight (After Feathering). (Aircraft with Modified Unfeathering System). Normal restart procedures apply except as noted below:

CAUTION

After ignition switches are turned on, do not press starter button with propeller windmilling, as severe damage to starter and engine will result.

1. Ignition switches - ON.

2. Throttle - Forward (1 inch).

3. Mixture - FULL RICH.

4. Propeller - INCREASE.

NOTE

The propeller will automatically windmill when the propeller lever is moved out of the feather position. If propeller fails to unfeather, proceed with ENGINE RESTART DURING FLIGHT procedures.

5. Propeller - Retard to detent when RPM reaches 1000 RPM.

g. Engine Restart During Flight (After Feathering).

NOTE

> ***If auxiliary fuel pump is in ON position, purge engine by turning auxiliary fuel pump off, throttle full open, and mixture IDLE CUT-OFF for five minutes prior to restart.***

If it appears reasonably safe to attempt a restart after the cause of the engine malfunction has been determined, use the following procedure:

1. Ignition switches - ON.
2. Throttle - Set.
3. Prop - DECREASE.
4. Mixture - FULL RICH.
5. Starter - As required.
6. Boost pump - ON/Prime as required.
7. Boost pump - Off.

h. Clean Up Procedure After Engine Feathering or Unsuccessful Air Start.

1. Fuel selectors - As required.
2. Ignition - Off.
3. Boost pump - Off.

i. Single Engine Descent/Arrival Check.

1. Passengers - Alerted.
2. Seat belts/shoulder harness - Secure.
3. Mixture - As required.
4. Fuel selector - MAIN.

j. Single Engine Before Landing Check.

1. Boost pump - ON.
2. Prop - 2450 RPM.
3. Flaps - 15° (below 140 MPH).
4. Landing gear - DOWN (below 140 MPH).
5. Landing lights - Extend/ON (below 140 MPH).

k. Single-Engine Landing Check. Fly a normal pattern and perform Before Landing checks. If altitude cannot be maintained while maneuvering for landing, the landing gear and flaps should be retracted, then extended and checked down when landing is assured. Do not extend full-flaps until gear is down and locked, and then only after there is no possibility of a go-around. Make a normal touchdown, reducing power during flareout. Avoid excessive or abrupt changes in power. A feathered propeller will result in less drag and may cause the aircraft to "float" during landing. After touchdown, apply brakes as required.

NOTE

> ***With full flaps and gear down, level flight cannot be maintained on one engine.***

1. Landing gear - Recheck DOWN.
2. Propeller - INCREASE.

l. Single Engine Go Around. With one failed engine and the aircraft in a landing configuration (gear down, flaps extended 45°), level flight is not possible under any condition. Therefore, the decision to go-around must be made while still high enough (approximately 300 feet) to allow for loss of altitude while retracting gear and flaps. Refer to Appendix I for Single-Engine Climb charts.

1. Power - Maximum controllable.
2. Landing gear - UP.
3. Wing flaps - 15°.
4. Carb Air/ind air - COLD/Air.
5. Flaps - UP (95 MPH).
6. Airspeed - Best S/E rate of climb (Vyse).
7. Landing lights - As required.

m. Landing with Both Engines Inoperative. In the event of failure of both engines, a maximum gliding distance (approximately two nautical miles per thousand feet of altitude) can be obtained by feathering both propellers and maintaining 107 MPH IAS with the landing gear and wing flaps up. Refer to the Maximum Glide diagram, figure 3-2, for maximum glide data.

1. Passengers - Alerted.
2. Seat belts/shoulder harness - Secure.
3. Mixture levers - ICO.
4. Propeller levers - FEATHER.
5. Fuel selectors - OFF.
6. Airspeed - 107 MPH.
7. Landing gear - As required.

NOTE

Extend landing gear if field is smooth and hard. Plan wheels up landing if the surface is soft/rough.

8. Wing flaps - As required.
9. Battery switch - As required.
10. Unlatch cabin door and jettison emergency exit window prior to flare out.
11. Landing lights - As required.

n. Engine Shutdown in Flight.

1. Fuel - OFF.
2. Boost pump - Off.
3. Mixture - ICO.
4. Propeller - FEATHER.
5. Ignition - Off.

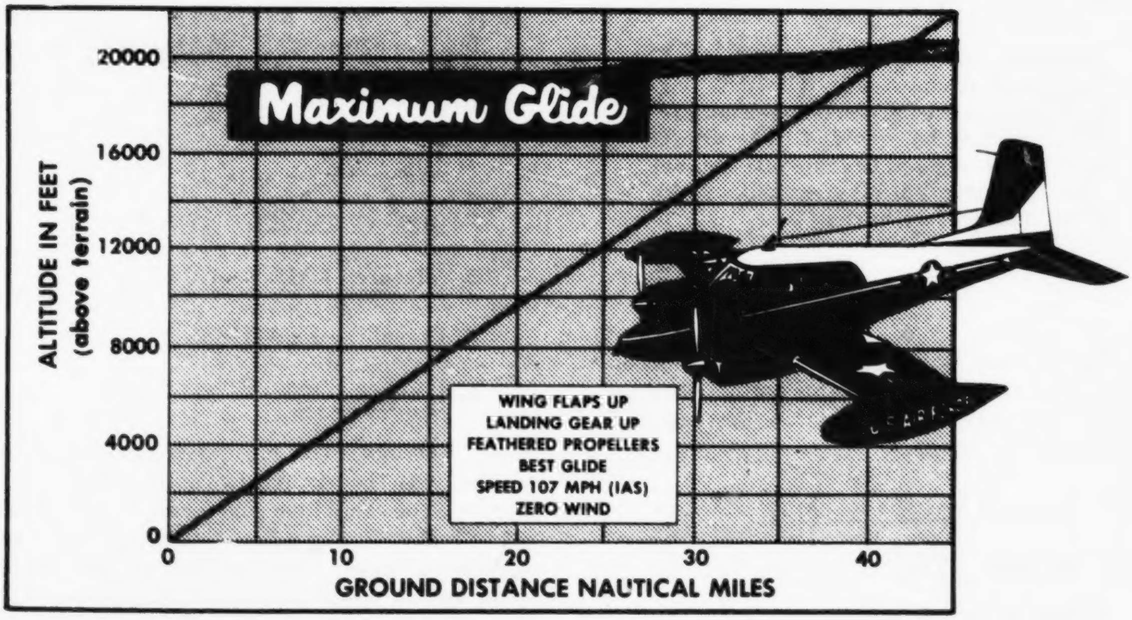


Figure 3-2.

3-7. Propeller Failure. Propeller failures which do not result in a feathered propeller due to loss of oil supply or propeller governor failure will result in a propeller overspeed condition. In the event of an uncontrollable overspeed propeller condition, proceed as follows:

1. Airspeed - Reduce (Increase pitch attitude).

2. Power - Reduce.

3. Propeller lever - Retard to detent (faulty propeller).

NOTE

If control is not regained by moving propeller lever from INCREASE to detent several times, shut down the engine. If the propeller fails to feather, restart the engine and use the maximum power without exceeding RPM limits; maintain 100-110 MPH IAS and land as soon as practicable.

WARNING

Exposure to high concentrations of Bromotrifluromethane (CF3BR) extinguishing agent or decomposition products should be avoided. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns.

3-8. Fire.

a. Engine Fire During Start. If fire breaks out during engine starting and engine has not yet started, continue cranking engine in an effort to draw fire through the engine.

1. Starter - Continue cranking.

2. Throttle - OPEN.

IF FIRE CONTINUES:

3. Fuel - OFF.

4. Mixtures - ICO.

5. Ignition switches - Off.

6. Battery - Off.

7. Abandon aircraft and use fire extinguisher.

NOTE

If fire is not stopped, discontinue cranking and signal ground crew to use fire extinguisher. Shut down other engine and turn off battery and ignition switches (gang-bar). If fire extinguishers are used on engine, do not attempt restart until engine has been checked and released for flight by maintenance personnel.

b. During Ground Operation.

1. Fuel - OFF.

2. Mixtures - ICO.

3. Ignition switches - Off.

4. Battery - Off.

5. Abandon aircraft and use fire extinguisher.

c. Engine Fire in Flight.

1. Fuel - OFF.

2. Boost pump - Off.

3. Mixture - ICO.

4. Propeller - FEATHER.

5. Ignition - Off.

d. Fuselage Fire. Most fuselage fires can be reached with the portable fire extinguisher which is stored on the cabin floor just forward of the copilot's seat. Combat fuselage fires by closing pilot's storm window (if open), and positioning the cabin air knob, defrost knob, forward cabin air knob (U-3B), and all air vents to the CLOSED position, to keep drafts to a minimum. Use oxygen as soon as possible. Turn off cabin heat switch and all other electrical equipment. Use fire extinguisher as necessary. Immediately after fire is extinguished, position cabin air knob, defrost knob, forward cabin air knob (U-3B), heating registers, and air vents to the OPEN position to clear cabin area of toxic fumes.

1. Storm window - Closed.
2. Air Vents - Closed.
3. Cabin heater - Off.
4. Electrical switches - OFF.
5. Fire extinguisher - As required.
6. Ventilation system - Open (after fire is out).

WARNING

Prolonged exposure (five minutes or more) to high concentration of Bromochloromethane (CB) or its decomposition products should be avoided.

e. Electrical Fire. Circuit breakers isolate all electrical circuits in the aircraft and automatically interrupt power to prevent a fire when a short occurs. If electrical power is essential, as during instrument flight, attempt to identify and isolate the shorted circuit as soon as possible.

1. Battery - Off.

2. Generators - Off.

3. Electrical switches - OFF.

4. Battery - ON.

5. Generators (individually) - ON.

6. Essential Equipment - On individually until faulty circuit is isolated.

3-9. Fuel System Failures.

a. Fuel Pressure/Fuel Flow Drop (Engine Operating Normally). If the fuel pressure or fuel flow drops below the operating limits, but the engine continues to operate normally, the cause may be one or more of the following: primer leakage; oil dilution solenoid leakage; engine driven fuel pump bypass valve leakage; clogged pressure line; instrument failure; or line leakage. Whenever fuel pressure or fuel flow drops and the engine continues operating normally, the first concern of the crew must be to guard against the outbreak of an engine fire. The greatest danger lies in the fact that the crew develops a false sense of security because no fire exists at the time that the fuel pressure or fuel flow drop are noticed. However, when the throttle is retarded (as in preparation for a landing), an engine fire may develop and the results are usually disastrous. The cooling and dispersing effects of the airflow through the engine nacelle at crusing speed have prevented the start of a fire. When the throttle was retarded, the airspeed dropped and the airflow was reduced sufficiently to permit ignition of the leaking fuel. Any change in the airflow pattern, such as feathering the propeller or entering a climb, can start a fire if a fuel leak exists. Increasing the power is less likely to start a fire since airspeed will be increased, but even here there is a possibility of fire since the exhaust heat and flame pattern may change sufficiently to outweigh the increase in cooling airflow. Accordingly, it must be the objective of the crew to eliminate the fuel before any change is made to the airflow or exhaust pattern. **The most effective means of accomplishing this is by moving the fuel selector valve handle to off and the mixture lever to idle cut-off before any throttle reduction, propeller feathering, or any other engine shutdown procedure are initiated.** An additional advantage of moving the selector lever to OFF is that it provides fuel shutoff closest to the fuel supply.

b. On the Ground. If the fuel pressure or fuel flow drop below the operating limits, but the engine continues to operate normally, stop the aircraft, shut down the engine and summon fire fighting assistance. **Do not takeoff.** Investigate the cause and have malfunction corrected.

NOTE

If the fuel pressure or fuel flow should drop after extended static ground runup or with ambient temperature conditions at or above 90°F., cause may be due to a fuel vapor condition developing in the accessory section.

c. In Flight. If it can be determined that a fuel leak exists, the affected engine should be shut down immediately. If the cause of the fuel pressure or fuel flow drop indication cannot be determined, you may elect either to continue normal operation or shut down engine. In deciding, all factors should be considered; power requirements, stage and urgency of the mission, known condition of the aircraft, etc. If the decision is to continue flight, a constant watch for fire should be maintained. Because of the danger of backfire, **under no conditions should the throttle be retarded when a fuel leak is even suspected.** If the engine is to be shut down, use the following procedure:

1. Fuel selector - OFF.

2. Mixture lever - ICO (before throttle reduction).

3. Propeller - FEATHER.

4. Boost pump - Off.

5. Ignition - Off.

d. Engine Driven Fuel Pump Failure.

1. Boost pump - ON.

2. Land as soon as practicable.

e. Fluctuating Fuel Pressure/Flow.

1. Mixture lever - FULL RICH.

2. Boost pump - ON.

3. Mixture lever - As required.

3-10. Electrical System Failure.

a. Complete System Failure. If a complete electrical failure occurs, or if it becomes necessary to turn off both the battery switch and generator switches, a landing should be made as soon as possible, since all electrical equipment will be inoperative.

b. Generator Failure. If one generator is inoperative, the other generator and battery will supply all the current to the electrical system. Check the inoperative generator circuit breaker and reset it if it has popped out due to overload. If the circuit breaker pops out again, do not reset it. Turn off the inoperative generator switch. The other generator is capable of supplying the electrical current needed for most normal operations. However, the ammeter should be observed continuously to note when more electrical power is being used than is being supplied by the operative generator; if a discharge indication shows on the ammeter, all electrical equipment not necessary for safe flight, communication, and navigation should be turned off to conserve battery life. Perform the following procedure:

1. Generator circuit breaker - Reset.

2. Generator still inoperative - Land as soon as practicable.

3-11. Hydraulic System Failure. Not applicable.

3-12. Emergency Descent. Emergency descent is a maximum effort in which damage to the aircraft must be considered secondary to getting the aircraft down. For emergency descent, proceed as follows:

CAUTION

During practice emergency descent, do not allow airspeed to exceed 140 MPH IAS.

1. Throttles - Close.

2. Propellers - INCREASE.

3. Mixtures - FULL RICH.

4. Gear - DOWN.

5. Flaps - DN.

6. Airspeed - 160 MPH maximum.

3-13. Landing Emergencies.

CAUTION

Use the emergency hand crank only to extend the landing gear - never to retract the landing gear, as excessive loads may damage the mechanism.

a. Landing Gear System Failure. Before proceeding manually to lower the landing gear, place the landing gear circuit breakers to reset. Allow three minutes for circuit breakers to cool before resetting. However, if the circuit breakers are not tripped, place the landing gear switch in the off (middle) position. Tilt the seat back and remove the emergency hand crank from the stowage clip. Extend the crank until the hinged link is straight by rotating the crank slightly clockwise to engage extension mechanism gear teeth. Grasp the crank handle firmly and crank the gear down approximately two turns past the point where the gear down indicator light (green) comes on. Approximately 57 turns of the crank are required to lower the gear from the full up position. You should be able to feel the cranking forces, as the gear is lowered, indicating that the gear has reached the overcenter and locked position. Check the gear down indicator light. After the gear is extended, depress the button on the hinged crank link, and stow the hand crank in the stowage clip. Readjust the seat as required for landing. Place the seat as required for landing. Place the landing gear switch in the DOWN position. The possibility of damage to the actuator system is considered secondary to the damage that may occur in inadvertent retraction of the landing gear upon landing.

CAUTION

During demonstration do not place the landing gear switch in the DOWN position after manual extension of the gear. If the emergency hand crank was operated an excessive number of turns while lowering the landing gear manually, the landing gear actuator bell crank may have been forced past the design travel of the landing gear actuator. If this occurs, and the landing gear switch is then placed in the DOWN position, the motor may drive the actuator into its mechanical stops, damaging the landing gear actuating system.

NOTE

Failure to completely disengage the hand crank will prevent retraction if it becomes necessary. Readjust the seat as desired for landing. Place the landing gear switch in the DOWN position. The possibility of damage to the landing gear actuator system is considered of secondary importance to the damage that may occur in inadvertent retraction of the landing gear upon landing.

1. Gear switch - DOWN.

2. Gear indicator lights circuit breakers - Check.

3. Gear motor/relay circuit breaker - Check.

4. Indicator bulbs - Check.

5. Gear - Recycle.

6. Gear position - Check. If possible have other aircraft visually verify landing gear position.

b. Emergency Landing Gear Extension.

1. Gear switch - Off (Middle).

2. Crank gear down approximately 2 turns past green light (app. 57 turns).

3. Gear indicator light - Rechecked down.

4. Emergency Hand Crank - Stowed.

5. Gear switch - DOWN.

c. Gear-Up Landing.

NOTE

If time permits, rotate propellers to horizontal with starter after feathering. Propeller may not remain in horizontal position at higher airspeeds.

1. Flaps - Set (20° at 95 mph).

2. All electrical switches - OFF.

3. Unlatch cabin door and jettison emergency exit window prior to flare out.

4. Mixtures - ICO.

5. Ignition - Off (prior to ground contact).

d. Nose Gear Up or Unlocked. If the nose gear fails to extend or lock, then attempt to extend the gear manually using the procedure described in LANDING GEAR SYSTEM-EMERGENCY OPERATIONS, this section. If a malfunction is then verified by observers in the control tower or other aircraft, prepare for a wheels down landing as follows: Select a smooth, hard surface, or sod runway. Move loose objects to the baggage compartment, passengers to available rear seat, and set up normal approach for landing. Place landing gear switch in the DOWN position and turn off all electrical switches. Land in a slightly tail low attitude. At touchdown, cut mixtures, feather props, turn off fuel selector handles and ignition switches. Hold the nose off the ground as long as possible during landing toll and evacuate the aircraft as soon as it stops.

1. Passengers - Rear seats.

2. Before Landing Check - Complete.

3. Electrical switches - OFF.

4. Mixture - ICO (At touchdown).

5. Propellers - FEATHER.

6. Fuel - OFF.

7. Ignition - Off.

8. Abandon aircraft when stopped.

e. One Main Gear Up or Unlocked.

1. Passengers - Rear seats.

2. Before landing check - Complete.

3. Flaps - Set (30°).

4. Electrical switches - OFF.

5. Mixture - ICO (at touchdown).

6. Propellers - FEATHER.

7. Abandon aircraft.

f. Landing With One Main Gear Extended. Landing in this configuration (one main gear and nose gear retracted) should only be attempted if additional gear cannot be extended by using procedure described in LANDING GEAR SYSTEM - EMERGENCY OPERATION, or if the offending gear cannot be retracted manually, so as to effect a belly landing. Reduce fuel load to minimum and prepare to land as follows: Select a wide, hard-surface runway, or if necessary, a wide sod runway. If a crosswind landing is required, select a runway with crosswind from the side opposite the defective landing gear. After moving any loose objects to the baggage compartment, and passengers to available rear seat space, set up normal approach for landing, with flaps 30° deflected. In approach, align aircraft with the center of the runway or landing area. Land slightly wing low towards the operative main landign gear. At touchdown, turn off battery, cut mixtures, and lighten load on defective gear with aileron. Do not apply brakes, maintain directional control as long as possible with rudder, land in the nose-high attitude and hold the nose off the ground as long as possible during landing roll.

CAUTION

If blowout occurs with gear extended, do not retract gear. Land slightly wing low on the side of the inflated tire and lower the nose wheel to the ground immediately to facilitate steering. During landing roll, the aircraft will have a tendency to veer in the direction of the defective tire due to increased ground-wheel friction. Partial compensation for this can be effected by using full aileron to lighten the load on the defective tire. Minimize the landing roll and attempt to maintain directional control by applying the brake on the inflated tire side only. This procedure will also apply should a tire blow out in flight and gear is already extended or can be extended and locked in the down position; otherwise, accomplish a belly landing.

g. Landing With Flat Tire. If a blowout occurs during takeoff, prior to normal gear retraction point, it is recommended that the gear be left in the extended position since in all probability the blown-out tire will wedge in the wheel well or against the landing gear door.

CAUTION

If a blowout occurs with gear extended, do not retract gear.

h. Landing With Flat Nose Gear Tire. If a blowout occurs on the nose gear tire after takeoff prior to gear retraction, it is recommended that the gear be left in the extended position since the nose gear may be distorted enough to bind the nose wheel strut within the wheel well. After moving any loose objects to the baggage compartment and passengers to available rear set space, accomplish appropriate normal checklists and set up a normal approach for landing. It is recommended that full flaps be used during the landing. Land in a nose high attitude and hold the nose wheel off the ground as long as possible during the landing roll. If power was used, retard the throttles immediately after touchdown. During the initial landing roll, brakes should not be used. As the landing roll speed diminishes and the nose wheel contacts the runway, hold the control wheel full aft and apply minimum braking until the aircraft comes to a stop. This procedure will also apply should the nose tire blow out in flight and gear is already extended or can be extended and locked in the down position; otherwise, follow procedures described in paragraph

1. Flaps - Set (45°).
2. Flat nose tire - Use minimum braking.

3-14. Ditching. If it is necessary to ditch the aircraft, follow the radio distress procedure. Make sure that all personnel are free of equipment such as headsets, oxygen, masks, etc., and stow this equipment prior to touchdown. Check that seat belts are pulled tight. Instruct passengers to lean forward as far as possible and protect their heads with their arms, cushions, or pillows. Plan approach into the wind if wind is high and seas are heavy. With heavy swells and light wind, land parallel to swells being careful not to allow a wing tip to hit first. Approach with the landing gear retracted,flaps 45°, and enough power to maintain approximately 300 ft/min rate of descent at approximately 95 MPH IAS at 3500 pounds to 108 MPH IAS at 4600 pounds gross weight. Maintain a continuous descent until touchdown to avoid flaring and touching down tail first, pitching forward sharply, and decelerating rapidly. Strive for initial contact at fuselage area below rear cabin section (point of maximum longitudinal curvature of fuselage). It is expected that the aircraft will skip clear of the water once or twice using the optimum technique outlined above. If the final contact is made in the desired level attitude, the nose will submerge completely during two or three seconds of moderately abrupt deceleration, and then the aircraft will float for a short time in a nearly level attitude. The length of floatation time will depend on the extent of damage to nose and main gear doors, tip tanks, nacelle firewalls, fuselage bottom and wings. However, it is believed that the aircraft would settle rather slowly especially with empty fuel tanks.

1. Radio - Distress procedure.
2. Personnel - Alerted.
3. Equipment - Stowed.
4. Seat belts/shoulder harness - Secure.
5. Gear - UP.
6. Flaps - DN.
7. Power - As required to maintain 300 FPM descent.
8. Touchdown - Level attitude.

3-15. Flight Procedure for Open Cabin Door. Airflow over the curved cabin door produces negative pressure over the door surface, resulting in an outward pull force that increases with speed. Consequently, if the door should open accidentally in flight because of insecure locking, it will float outward enough to disturb the airflow over the tail, causing moderate buffeting of the tail. This buffeting attains its maximum with gear up, flaps 20°, and 80 MPH IAS, and occasionally produces a noticeable nose down pitch and possibly a slight roll as the door pops open. Although these motions are controllable, it is best to avoid this situation close to the ground. Therefore, checking the door handle before takeoff is important. If the cabin door comes open in flight, a landing should be made so the door can be securely locked. If it is impractical to land, the door may be closed in flight by lowering the landing gear (below 140 MPH IAS), fully extending the wing flaps (below 140 MPH IAS), and opening the pilot's storm window (below 130 MPH IAS). Then slow the aircraft to 95 MPH IAS. Grasp the door arm rest with one hand and the interior door handle with the other hand. Momentarily push the door open against the slipstream and then slam the door hard. Push the interior door handle full forward to lock the door.

NOTE

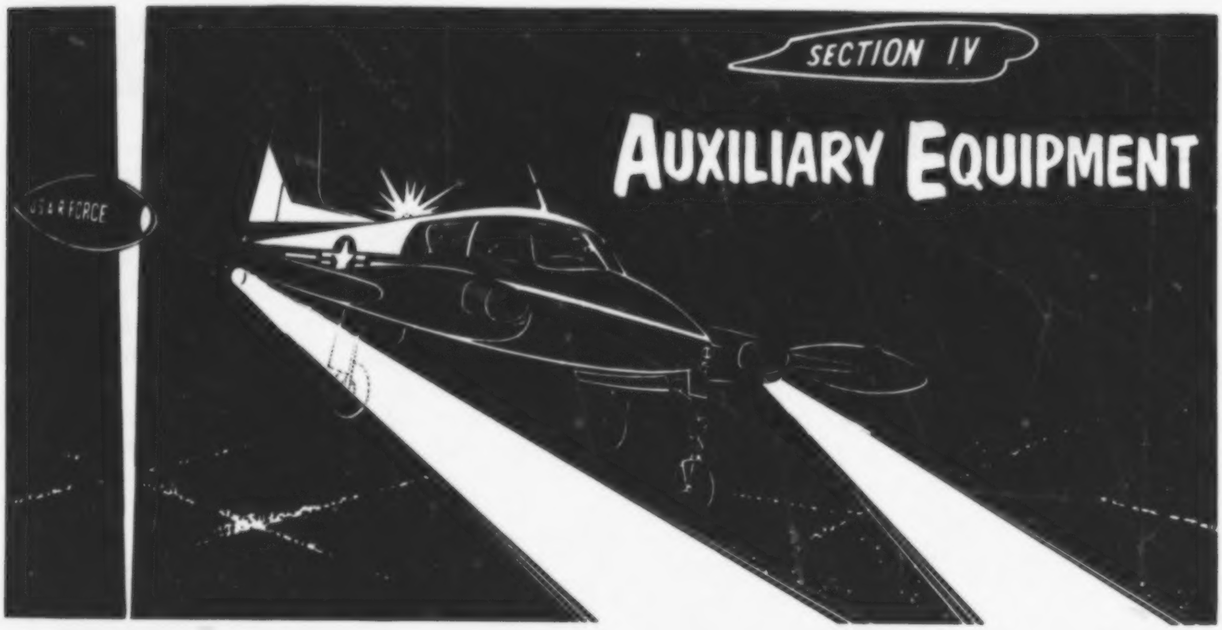
The door can be closed in flight, but it is very difficult, and at times impossible, to lock the door in flight.

Normal cruise speeds may be maintained with the door unlocked; however, the air noise may be very annoying if endured for prolonged periods.

3-16. Flight Controls Emergency. An asymmetrical flap condition is a malfunction which results in split-flaps. When split-flaps symptoms occur, proceed as follows: If flaps can be retracted, a landing should be accomplished in the no-flaps configuration. In the event the flaps cannot be retracted, counteract the roll and yaw differential power. Check flight characteristics in landing configuration and land as soon as possible

1. Flaps - Retract.

2. If unable - Use aileron and differential power as required.



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HEATING, VENTILATING, AND DEFROSTING SYSTEM.

The heating, ventilating, and defrosting system (figure 4-1; figure 4-2) provides heated or ventilating fresh air to all areas of the cabin both on the ground and in the air. It consists of an air inlet in the nose of the aircraft, a gasoline combustion type heater, ducting, and ten controllable air outlets in the cabin. A ventilating fan is located on the forward end of the heater and provides air to the system when the aircraft is on the ground. The fan automatically becomes inoperative when the landing gear is retracted as the ram air in flight makes the fan unnecessary. The heated or ventilating air is not recirculated for heater operation, but is exhausted into the slip-stream through a cabin air outlet.

HEATING AND DEFROSTING SYSTEM. ▲▲

Air, picked up from the front opening in the nose of the aircraft, is heated by a gasoline combustion type heater and is ducted into the front and rear cabin compartments. Heated air enters the front compartments through four outlets: two registers mounted just forward of the rudder pedals, and two defroster outlets located at the base of the windshield. Heat is supplied to the rear cabin compartment through two registers mounted under the front seats. Controls are provided to regulate cabin air temperature and to regulate the flow of air through each cabin air outlet. The heater and ventilating fan are controlled by a toggle switch. If at any time during heater operations, the temperature of the ventilating air streams should exceed 250°F, a bimetallic overheat switch, located on the heater shroud, will automatically open and shut off fuel flow to the heater. An overheat warning light will illuminate whenever this condition exists. When the heat exchanger has cooled sufficiently, the warning light will go out and the heater will then restart itself. This cabin heater depends upon the aircraft fuel supply system for fuel supply and fuel pressure. Thus, at least one fuel boost or engine-driven fuel pump must be operating whenever the heater is used. Fuel flows through a safety valve and a fuel control valve to the heater. The safety valve provides the initial flow of fuel for ignition and will automatically shut off the fuel supply from the heater whenever the heater is turned off or if the heater should overheat. The fuel control valve provides the proper amount of fuel for high or low heat operation, depending on the requirements. The fuel consumption rate for the heater is 0.3 gallons per hour. On the ground, the cabin heating system can be utilized for ventilation by placing the heater switch in FAN position. The fan provides unheated, fresh air, to the cabin through the cabin heater registers. In flight, the fan becomes inoperative and the heating sys-

HEATING, VENTILATING *and Defrosting System Schematic* ⚠1 ⚠2

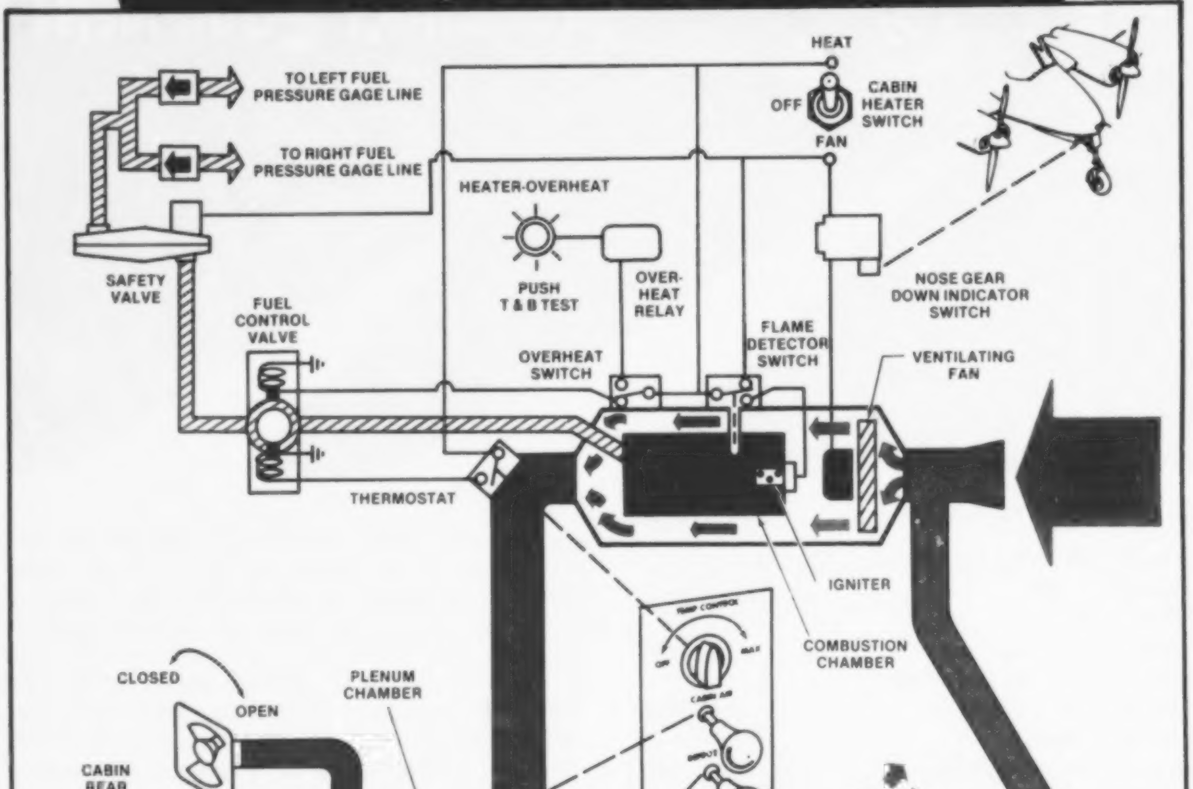


Figure 4-1

tem can be utilized as a ventilating system by turning the heater switch to the OFF position and opening the heater registers as desired.

Note

Fuel pressure fluctuation will occur during heater operation.

Cabin Heater Switch. ⚠ ⚠

The cabin heater and ventilating fan are controlled by a three-position toggle switch (21, figure 1-7) located on the left switch and control panel. The switch positions are HEAT (up position), OFF (middle position), and FAN (down position). Placing the switch in the HEAT position starts and maintains heater operation. Placing the switch in the FAN position performs two functions: (1) it operates the ventilating fan so that cool, ventilating air can be circulated through the heater ducting and (2) it energizes the safety valve which primes the heater for its next starting operation. When the small priming chamber is full (approx. 2 fluid ounces) the fuel flow is automatically cut-off, thus there is no consumption of fuel when the switch is left in the FAN position.

Cabin Air Temperature Control Knob. ⚠ ⚠

Cabin air temperature is regulated by operating a rotary type control knob (3, figure 1-10) located on the right switch and control panel. The knob is labeled TEMP CONTROL, OFF (counterclockwise position), and MAX (clockwise position). Clockwise rotation of the temperature control knob increases cabin temperature and counterclockwise rotation decreases it. This knob mechanically controls the setting of a thermostat located within the ducting just aft of the cabin heater. The thermostat maintains an even temperature within the duct at all times, thus maintaining an even temperature in the cabin. When the temperature reaches the selected setting of the thermostat, the heater is switched from high to low heat and continues to operat low heat. When the temperature drops below the setting of the thermostat, the heater switches to high heat operation. The heater cycles between high and low heat positions to maintain an even cabin temperature.

Cabin Air Knob. ⚠ ⚠

The push-pull knob (4, figure 1-10) labeled CABIN AIR on the right switch and control panel regulates the air flow to all cabin heat registers. When the knob is pulled out, air flows to the registers. When it is pushed all the way in, the air is shut off completely. Air flow may be regulated by placing the knob in the desired intermediate position; the control may be locked by turning the knob clockwise to engage a detent with the slotted control shaft.

Defrost Knob. ⚠ ⚠

Air for windshield defrosting and defogging is controlled by a push-pull knob (7, figure 1-10) labeled DEFROST on the right switch and control panel. When the knob is pulled out, air flows from the defroster outlets at the base of the windshield. When the knob is pushed all the way in, the air is shut off. Intermediate positions of the knob may be used to regulate the volume of air and the control may be locked by turning the knob clockwise to engage a detent.

Pilot's and Copilot's Heater Registers. ⚠ ⚠

Two slide type registers (6 and 11, figure 1-3) are provided, one just forward of each set of rudder pedals, to control the amount of air emitting from the pilot's and copilot's heat registers. Each of the registers contains a slide valve incorporating a large tab which permits toe-operation of the valve. Each front seat occupant can operate the register in front of him by moving his inboard foot forward over the rudder pedal and engaging his toe with the valve tab. Each sliding valve is OPEN when moved inboard, and CLOSED when moved outboard. The valves may be placed in any intermediate position to regulate the amount of air flow.

Cabin Rear Heater Registers. ⚠ ⚠

Two heater registers (12, figure 1-17; and 8, figure 1-18) are provided, one under each front seat on the aft side of the front spar, to regulate the amount of air flowing to the rear seat passengers. A rotary type slide valve is incorporated in each register. The registers are OPEN when rotated clockwise, and CLOSED when rotated counterclockwise. The registers may be set in any intermediate position to regulate the amount of air emitting from the registers.

Overheat Warning Light. ⚠ ⚠

An amber overheat indicator light (10, figure 1-24) is located on the instrument panel just below the clock and is labeled HEATER-OVERHEAT, T & B TEST. This light will illuminate whenever the air temperature in the heater shroud exceeds 250°F. Overheating is most commonly caused by heater operation with both cabin air and defrost knobs pushed all the way in. This condition stops the flow of air to the cabin heat outlets and registers, resulting in a stagnation of air around the heater. Pulling out either or both of the cabin air and defrost knobs permits air to flow around the heater, and thus eliminating the overheat condition. If the heater continues to cycle on and off after corrective action has been taken, the cabin heater switch should be turned OFF because a malfunction exists.

Normal Operation of Heating and Defrosting System. ▲▲

1. Battery switch—ON.
2. Fuel selector valve handle—MAIN (if engines are not running).
3. Fuel boost pump (left or right)—ON (if engines are not running).
4. Cabin air knob—Full in.
5. Defroster knob—Full in.
6. Temperature control knob—Maximum
7. Cabin heater switch—FAN for 30 seconds.

Note

This operation primes the heater.

8. Cabin heater switch—HEAT.
9. After 30 to 40 seconds (or when heater overheat warning light illuminates), pull cabin air knob full out.

CAUTION

Be sure that some of the heat registers are OPEN. If all registers are CLOSED, air will not circulate through the system and the heater will overheat.

Note

Warm air should be felt coming out of the heat registers within one minute. If heater does not start, reprime heater by positioning cabin heater switch to FAN for 30 seconds and then return to HEAT. If heater still does not start, return switch to OFF and check circuit breaker labeled CABIN HEAT (8, figure 1-20). If heater does not ignite after third attempted start, service is required and no further attempt should be made.

10. Temperature control knob—As desired (after heater has been operating for one minute).
11. Defrost knob—As desired.
12. Cabin air knob—As desired.
13. Heat outlet registers—As desired.

Heater Shut-Down. ▲▲

1. Battery switch—Check ON.
2. Defrost or cabin air knob—Full out.
3. Cabin heater switch—OFF.

Note

The heater combustion fan and ventilating fan (on ground only) will continue to operate, thus cooling the heater. When the heater has cooled sufficiently, a thermostat switch will automatically turn off the fans.

4. If engines have been shut down, turn battery switch OFF after heater has shut itself off.
5. Defrost knob—As desired.
6. Cabin air knob—As desired.

Normal Operation of Heating and Defrosting System for Ventilation. ▲▲

1. Battery switch—ON.
2. Cabin heater switch—FAN if on the ground, or OFF if in flight.
3. Cabin air knob—Full out.
4. Heat registers—As desired.
5. Defrost knob—As desired.
6. Cabin air knob—As desired.

Emergency Operation of Heating and Defrosting System. ▲▲

1. Should smoke or fumes enter the cabin from the heating system, move cabin heater switch to OFF and push cabin air and defroster knobs full in. Open air vents for ventilation.

2. If cabin heater warning light comes ON, pull cabin air and defroster knobs full out and open pilot and copilot heat registers. If warning light continues to cycle on and off, turn cabin heater switch to OFF.

HEATING AND DEFROSTING SYSTEM. ▲

Air, picked up from the front opening in the nose of the aircraft, is heated by a gasoline combustion type heater and is ducted into the front and rear cabin compartments. Heated air enters the front compartments through five outlets: one register mounted on either side of the cabin, one register mounted just forward of the copilot's rudder pedals, and two defroster outlets located at the base of the windshield. Heat is supplied to the rear cabin compartment through two registers mounted under the front seats. Controls are provided to regulate cabin air temperature and to regulate the flow of air through each cabin air outlet. The heater and ventilating fan are controlled by a toggle switch. If at any time during heater operation, the temperature of the ventilating air streams should exceed 220° F, a duck limit switch, located on the heater shroud, will automatically open and shut-off fuel flow to the heater. When the heat exchanger has cooled sufficiently, the heater will then restart itself. This cabin heater depends upon the aircraft fuel system for its fuel supply. Fuel pressure is supplied by a diaphragm-type fuel pump mounted on the heater assembly; the main fuel system boost pumps need not be turned on for proper heater operation. Fuel flows through a solenoid operated safety

HEATING, VENTILATING and Defrosting System Schematic ⚠

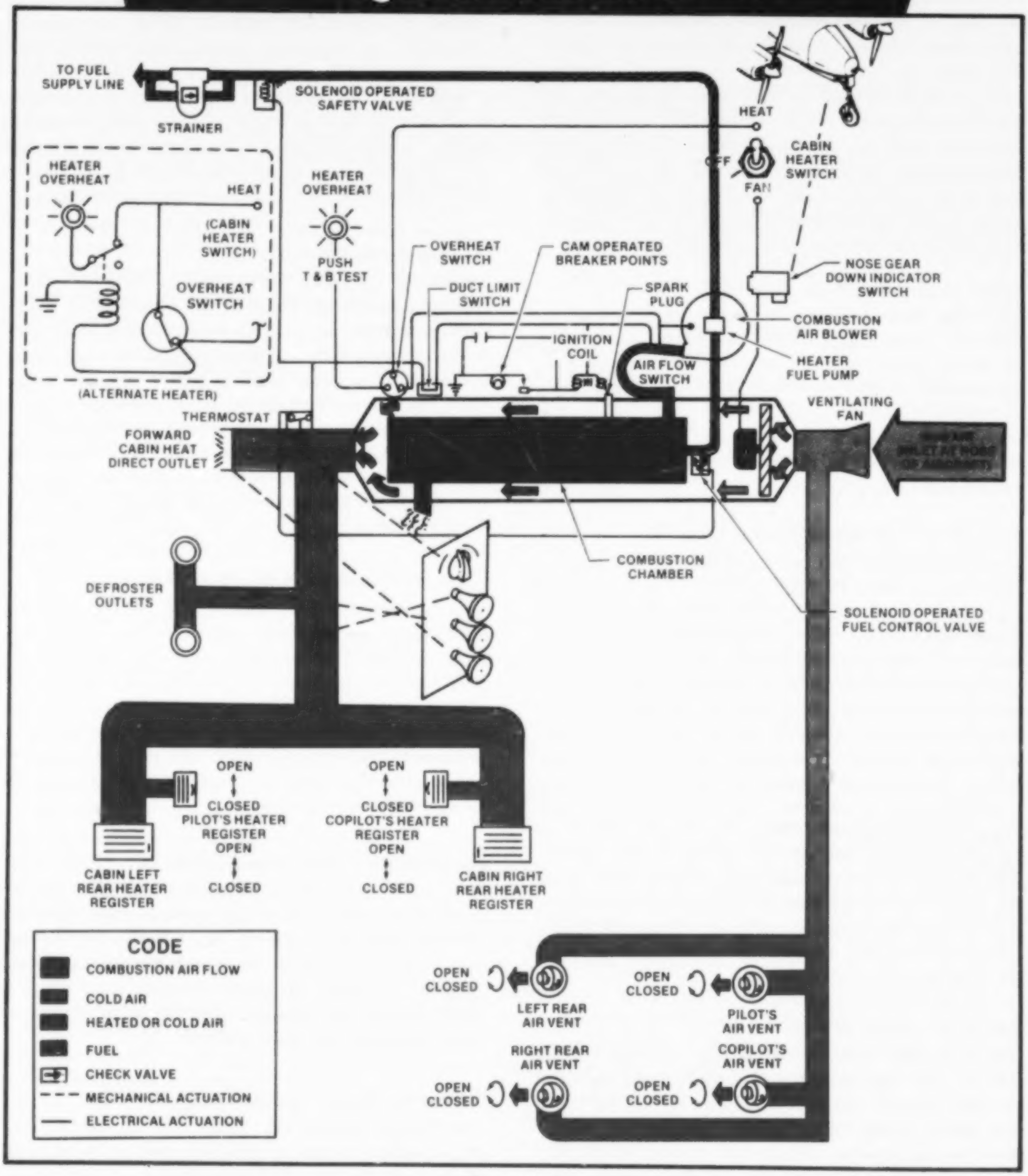


Figure 4-2

valve and a fuel control valve to the heater. The solenoid operated safety valve provides the initial flow of fuel for ignition and will automatically shut off the fuel supply from the heater when the heater is turned off or if the heater should overheat. The solenoid operated fuel control valve provides the proper amount of fuel for high or low heat operation, depending on the requirements. The fuel consumption rate for the heater is 0.6 gallons per hour. On the ground, the cabin heating system can be utilized for ventilation by placing the heater switch in the FAN position. The fan provides unheated, fresh air, to the cabin through the cabin heater registers. In flight, the fan becomes inoperative and the heating system can be utilized as a ventilating system by turning the heater switch to the OFF position and opening the heater registers as desired.

Cabin Heater Switch. ▲

The cabin heater and ventilating fan are controlled by a three-position toggle switch (21, figure 1-7) located on the left switch and control panel. The switch positions are HEAT (up positions), OFF (middle position), and FAN (down position). Placing the switch in the HEAT position starts and maintains heater operation. Placing the switch in the FAN position operates the ventilating fan only.

Cabin Air Temperature Control Knob. ▲

Cabin air temperature is regulated by operating a rotary type control knob (3, figure 1-11) located on the right switch and control panel. The knob is labeled TEMP CONTROL, OFF (counterclockwise position), and MAX (clockwise position). Clockwise rotation of the temperature control knob increases cabin temperature and counterclockwise rotation decreases it. This knob mechanically controls the setting of a thermostat located within the ducting just aft of the cabin heater. The thermostat maintains an even temperature within the duct at all times, thus maintaining an even temperature in the cabin. When the temperature of the heated air reaches the selected setting of the thermostat, the thermostat automatically opens and shuts off the heater. When the heated air cools to the thermostat setting, the heater starts again. Thus, the heater continuously cycles on and off to maintain an even air temperature.

Cabin Air Knob. ▲

The push-pull knob (4, figure 1-11) labeled CABIN AIR on the right switch and control panel regulates the air flow to all cabin heat registers except the cabin heat direct outlet. When the knob is pulled out, air flows to the registers. When it is pushed all the way in, the air is shutoff completely. Air flow may be regulated by placing the knob in the desired intermediate position; the control may be locked by turning the knob clockwise to engage a detent with the slotted control shaft.

Defrost Knob. ▲

Air for windshield defrosting and defogging is controlled by a push-pull knob (7, figure 1-11) labeled DEFROST on the right switch and control panel. When the knob is pulled out, air flows from the defroster outlets at the base of the windshield. When the knob is pushed all the way in, the air is shut off. Intermediate positions of the knob may be used to regulate the volume of air and the control may be locked by turning the knob clockwise to engage a detent.

Forward Cabin Air Knob. ▲

The forward cabin air knob (8, figure 1-11) located on the right switch and control panel is labeled FWD CABIN AIR, and controls the forward cabin heat direct outlet located on the right side of the forward cabin bulkhead. When the knob is pulled out, air direct from the heater flows from the forward cabin heat direct outlet. When the knob is pushed all the way in, the air is shutoff. Intermediate positions of the knob may be used to regulate the volume of air and the control may be locked by turning the knob clockwise to engage a detent.

Pilot's and Copilot's Heater Registers. ▲

Two controllable type registers (7, figure 1-17; 11, figure 1-18) are provided, one on either side of the cabin to control the amount of air emitting from the pilot's and copilot's heat registers. Each register contains a rotary type slide valve incorporating a tab which permits control of the valve. Each slide valve is labeled OPEN and CLOSED and may be placed in any intermediate position to regulate the amount of air flow from the registers.

Forward Cabin Heat Direct Outlet. ▲

A forward cabin heat direct outlet (7, figure 1-3) located on the right side of the forward cabin bulkhead, provides heated air direct from the heater for fast warm-up of the cabin when the aircraft is on the ground. The outlet incorporates a gate valve which is controlled by the forward cabin air knob located on the right switch and control panel.

Cabin Rear Heater Registers. ▲

Two heater registers (12, figure 1-17; 8, figure 1-18) are provided, one under each front seat on the aft side of the front spar, to regulate the amount of air flowing to the rear seat passengers. Each register is provided with a lever operated slide type valve which controls the amount of air coming from the passengers' registers. Each valve is OPEN when the lever is in the up position and CLOSED when in the down position. The valves may be placed in any intermediate position to regulate the amount of air coming from the registers.

Overheat Warning Light. ▲

An amber overheat warning light (10, figure 1-24) is located on the instrument panel just below the clock and is labeled HEATER-OVERHEAT, T & B TEST. When illuminated, the light indicates that the heater overheat switch has been actuated. This condition occurs only when the temperature of the air in the heater exceeds 325°F. Once the heater overheat switch has been actuated, the heater will not operate until a landing can be made and the switch reset. The overheat switch is mounted on the aft end of the heater, in the nose of the aircraft.

CAUTION

The heater should be inspected thoroughly to determine the reason for the malfunction prior to resetting the overheat switch.

Normal Operation of Heater and Defrosting System. ▲

1. Battery switch—ON.
2. Forward cabin air knob—Full out.
3. Cabin air knob—Full in.
4. Defroster knob—Full in.
5. Temperature control knob—Full clockwise.
6. Cabin heater switch—HEAT.

Note

Warm air should be felt coming out of the forward cabin direct outlet within approximately one minute. If the heater does not start return the heater switch to the OFF position, and check the cabin circuit breaker (8, figure 1-21). Place the cabin heater switch in the HEAT position and attempt another start. If the heater still does not start, service is required and no further starting attempt should be made.

7. Temperature control knob—Adjust as desired (after heater has been operating for one minute).
8. Cabin air knob—Full out.
9. Defroster knob—As desired.
10. Heat registers—Open as desired.

CAUTION

Be sure that some of the heat registers are OPEN. If all the registers are CLOSED, air will not circulate through the system and the heater will overheat.

11. Forward cabin air knob—Full in.

Heater Shut-Down. ▲

1. Cabin heater switch—OFF.

Normal Operation of Heating and Defrosting System for Ventilation. ▲

1. Battery switch—ON.
2. Cabin heater switch—FAN if on the ground, or OFF if in flight.
3. Cabin air knob—Full out.
4. Defroster knob—As desired.
5. Forward cabin air knob—As desired.
6. Heat registers—As desired.

Emergency Operation of Heating and Defrosting System. ▲

1. Should smoke or fumes enter the cabin from the heating system, move cabin heater switch to OFF and push cabin air knob, defrosting knob and forward cabin air knob full in. Open air vents for ventilation.

VENTILATING SYSTEM.

In addition to the ventilation provided by the cabin heating system, a separate ventilation system is provided which obtains ram air from the air inlet at the nose of the aircraft and ducts it to four air vents: two located on the instrument panel, and two on the side walls of the rear cabin compartment. The ventilating system is operative in flight only, since it depends entirely on ram air pressure. For ground ventilation, the ventilating fan of the heating system should be utilized.

Air Vents.

Four, manually-adjustable, air vents are provided to control the amount of fresh, ventilating air entering the cabin. Two of these air vents (32, figure 1-7; 5, figure 1-10; 5, figure 1-11) are located on the lower corners of the instrument panel for use by the pilot and copilot. Two additional air vents (20, figure 1-17; 5, figure 1-18) are located, one on each wall, in the rear cabin compartment for use by the rear seat passengers. The volume of air is regulated by turning a knurled ring which circumscribes the air vent opening. The air vents are OPEN when the knurled ring is rotated counterclockwise and CLOSED when rotated clockwise. The air vent is mounted in a socket so that it can be positioned to direct air as desired.

Operation of Ventilating System.

1. To provide a flow of air, turn knurled rings on

air vents counterclockwise.

2. To direct air, move air vents to position desired.
3. To stop flow of air through air vents, turn knurled rings full clockwise.

WINTERIZATION KIT. ▲ ▲

Winterization equipment consists of two piece removable engine cowl intake baffles, an oil cooler baffle and a cabin heater baffle. The engine baffles are installed in the left and right engine cowl air intakes, utilizing wing studs and grommets installed on the baffles. The baffle with stud grommets is installed inside the Nose Cap and the baffle with winged studs is installed outside. The oil cooler baffle is installed across the center of the oil cooler to restrict air flow, thereby preventive oil congealing in cold weather. The engine and oil cooler baffles can be installed and removed without hand tools. These baffles should be removed prior to flight when outside air temperature exceeds 20°F. The cabin heater baffle is installed between the inlet screen and fan housing in the nose of aircraft, utilizing hand tools. This baffle restricts the air flow, thereby increases the heater efficiency in cold weather. The baffle may be installed and removed at the user's discretion. When not in use, all baffles are stored in the baggage compartment.

Note

The oil cooler baffle is not required on aircraft equipped with non-congealing oil coolers.

WINTERIZATION KIT. ▲

Winterization equipment consists of two piece removable engine cowl intake baffles. These baffles are installed in the left and right engine cowl air intakes, utilizing wing studs and grommets installed on the baffles. The baffle with stud grommets is installed inside the nose cap and the baffles with wing studs is installed outside. These baffles can be installed or removed without hand tools. The baffles should be removed prior to flight when outside air temperature exceeds 20°F. When not in use, baffles are stored in the baggage compartment.

DE-ICING SYSTEM. ▲ ▲

The de-icing system (figure 4-3) consists of inflatable rubber de-icer boots cemented to the leading edges of the outer wing panels and horizontal stabilizers. Air for inflation of the boots is supplied by a high pressure reservoir (3, figure 1-2) mounted just aft of the baggage compartment. Fully-charged, the reservoir provides sufficient air for approximately 148 inflation cycles (3000 psi). A pressure gage is located on the back of the baggage compartment shelf and is calibrated in inflation cycles. Operation of the de-icing system is entirely manual. A shutoff valve at the reservoir is operated through a flexible push-pull control by the charge knob on the left switch and control panel. The cycle knob on the left switch and control panel operates the distributor valve behind the instrument panel. When the cycle knob is pushed IN, the distributor valve directs pressure to the boots, inflating them. When a preset pressure is reached, the distributor valve returns to its normal position, connecting the boots to the deflation vent and to the right engine vacuum pump, which aids in deflation and holds the boots in a completely deflated position. As the distributor valve returns to normal the cycle knob pops out. An adjustable pressure regulator is mounted on the reservoir and is fitted with both reservoir and regulated pressure gages, both calibrated in psi. The reservoir is charged through a high-pressure filler valve (5, figure 1-2) mounted behind a small access door on the left side of the fuselage.

WARNING

> Do not use oxygen or other corrosive or explosive gases in this system. These gases are both dangerous to use and detrimental to the de-icer materials.

DE-ICING CHARGE KNOB. ▲ ▲

The charge knob (30, figure 1-7) labeled CHARGE is located on the left switch and control panel and operates a shutoff valve at the reservoir through a flexible push-pull control. When the charge knob is in the PULL ON position the system is charged and ready for operation. When the knob is pushed IN the air supply is shutoff at the reservoir deactivating the system.

DE-ICING CYCLE KNOB. ▲ ▲

The cycle knob (31, figure 1-7) labeled CYCLE is located on the left switch and control panel and operates the distributor valve behind the instrument panel. When the cycle knob is PUSH IN, the distributor valve directs pressure to the de-icer boots, inflating them. As a preset pressure is reached and the distributor valve is returned to normal, the cycle knob pops out and is ready for another cycle. One cycle is defined as a complete inflation and deflation of the de-icer boots. Total cycles available are a function of reservoir pressure only (refer to figure 4-4).

DE-ICING CYCLE GAGE. ▲ ▲

The de-icing cycle gage (6, figure 1-19) is located on the back of the baggage compartment shelf and is calibrated in inflation cycles remaining in the reservoir. Fully-charged the cycle gage should show approximately 148 inflation cycles (3000 psi).

DE-ICING SYSTEM Schematic ▲▲

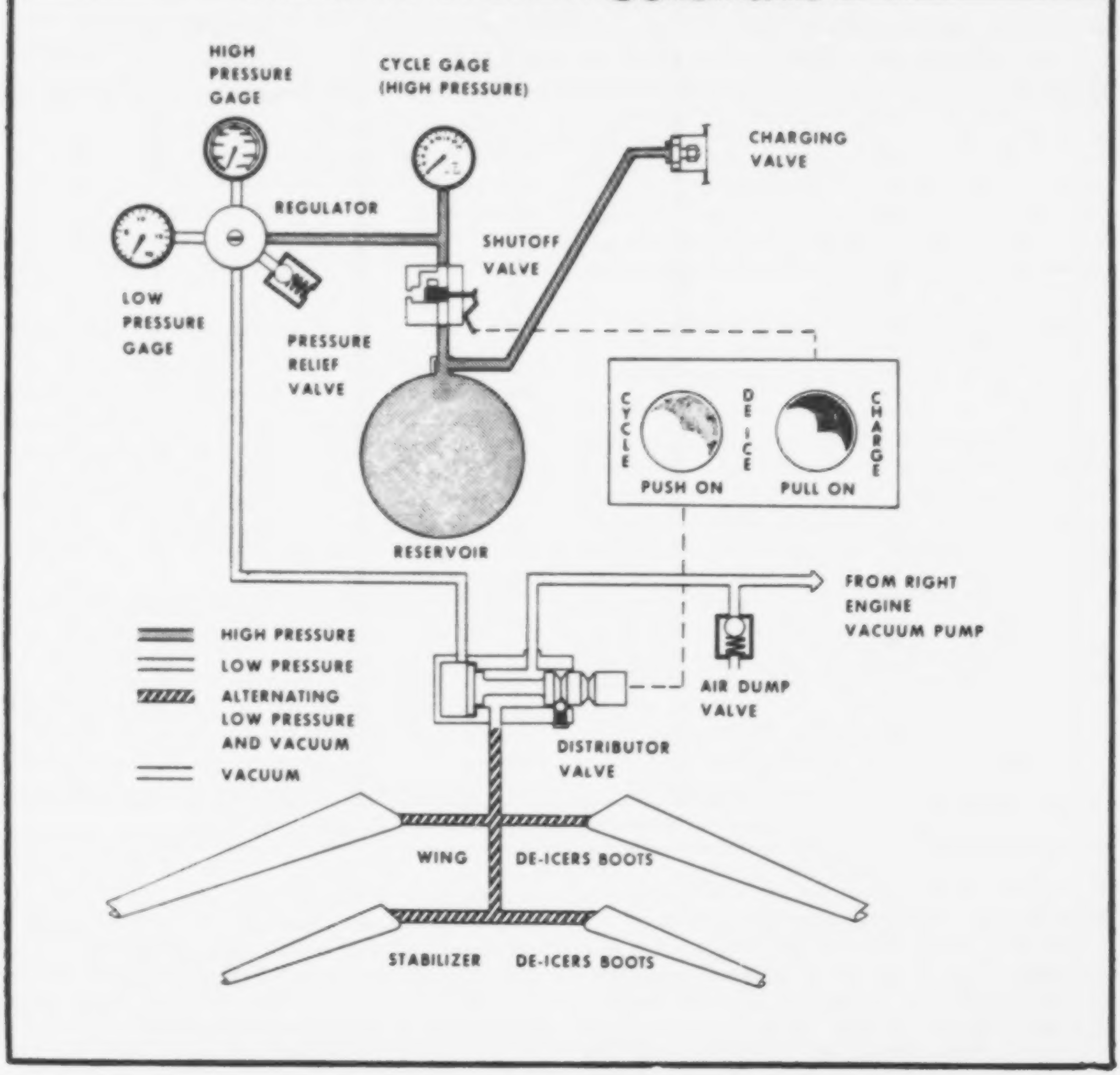


Figure 4-3

Note

The charge knob must be in the PULL ON position before the cycle gage will indicate the cycles remaining in the reservoir.

NORMAL OPERATION OF DE-ICING SYSTEM. ▲▲

The de-icer boots are intended to remove ice after it has accumulated rather than preventing its formation. Continuously cycling the boots will dissipate the pressure supply prematurely and may cause the ice to accumulate outside the contour of the inflared boots preventing its removal. Intermittent operation, removing the ice after it has accumulated, gives best results.

Note

Wing and horizontal stabilizer de-icer boots alone do not provide protection for the entire aircraft. If icing is encountered, close attention should be paid to the propellers, air induction systems and other components subject to icing.

DE-ICING SYSTEM DURATION CHART ▲▲

RESERVOIR PRESSURE (PSIG)	CYCLES AVAILABLE	ENDURANCE* HOURS	ENDURANCE* MIN.
100	4		12
200	9		27
300	14		42
400	19		57
500	24	1	12
600	29	1	27
700	34	1	42
800	39	1	57
900	44	2	12
1000	49	2	27
1100	54	2	42
1200	59	2	57
1300	64	3	12
1400	69	3	27
1500	74	3	42
1600	79	3	57
1700	83	4	9
1800	88	4	24
1900	93	4	39
2000	98	4	54
2100	103	5	9
2200	108	5	24
2300	113	5	39
2400	118	5	54
2500	123	6	9
2600	128	6	24
2700	133	6	39
2800	138	6	54
2900	143	7	9
3000	148	7	24

* Endurance calculated for a maximum icing condition and is rated at 1 cycle every 3 minutes.

Figure 4-4

When de-icing is required, proceed as follows:

1. De-icing charge knob—PULL ON.
2. When ¼ to ½ inch of ice builds up on the leading edges of the wings place the cycle knob in the PUSH ON position. When the de-icer boots become fully inflated, the distributor valve will snap shut connecting the de-icer boots and the vacuum lines, deflating the system.
3. Repeat inflation as required.
4. When de-icing is no longer required, place the charge knob in the IN position.

EMERGENCY OPERATION OF DE-ICING SYSTEM. ▲▲

If the distributor valve sticks in the inflation position, the cycle knob may be pulled out manually. If the knob pops out again immediately when placed in the PUSH ON position, it may be held in manually for the normal five to eight seconds inflation interval, then released or pulled out to deflate the boots. If the vacuum supply is lost, the boots will not deflate completely. However, they still may be operated, and deflation will be sufficiently complete for normal de-icing. No adverse aerodynamic effects will result in any allowable maneuver with partially deflated de-icer boots.

Note

With the left engine feathered, the vacuum instrument indication drops briefly as the de-icer boots deflate. With the right engine feathered the boots will not deflate to the vacuum hold-down condition. However, the normal elastic properties of the rubber boots prevents the boots from bulging due to the negative air pressure over the wing.

PROPELLER ANTI-ICE SYSTEM. ▲▲

The propeller anti-ice system will provide sufficient anti-ice fluid to the propeller blades for approximately

½ hour of operation under average icing conditions. The system consists of slinger rings on the propellers, to which anti-ice fluid is delivered by a motor-driven pump from a fluid reservoir (22, figure 1-2) in the right wing just outboard of the engine nacelle. The pump receives its power from the 28 volt dc bus which is controlled by a two position switch and a rheostat. At the pumps maximum flow, it pumps approximately one quart of anti-ice fluid to each propeller every four minutes. The system is protected by a push-to-reset type circuit breaker (24, figure 1-21) located on the circuit breaker panel. Refer to figure 1-2 for anti-ice fluid specification.

PROPELLER ANTI-ICE SWITCH. ▲ ▲

The propeller anti-ice switch (1, figure 1-11) labeled PROP ANTI-ICE is located on the right switch and control panel. The switch controls the electrically operated anti-ice motor-driven pump located in the right wing. The switch has two positions ON (up position) and OFF (down position). The switch is protected by a push-to-reset type circuit breaker (24, figure 1-21).

PROPELLER ANTI-ICE RHEOSTAT KNOB. ▲ ▲

The propeller anti-ice rheostat knob (10, figure 1-11) labeled PROP ANTI-ICE is located on the right switch and control panel. The rheostat is marked MIN (minimum flow rate) ½, ¾, and MAX (maximum flow rate); it may be set in any position between these points to provide the desired flow rate. The rheostat is protected by a push-to-reset type circuit breaker (24, figure 1-21).

NORMAL OPERATION OF PROPELLER ANTI-ICE SYSTEM. ▲ ▲

To operate the propeller anti-ice system proceed as follows:

1. Anti-ice switch—ON.
2. Anti-ice rheostat knob—MAX (turned full clockwise) for one minute to wet blades just before entering suspected icing conditions.
3. Anti-ice rheostat knob—MIN (counterclockwise position) and note sound of ice against the fuselage.

Note

> A slushing sound against the fuselage is desired, and fluid should be added if necessary until the slushing sound is heard. Sharp bangs indicate that the ice is solid and more fluid is required.

Under average icing conditions, the above procedure will provide approximately one-half hour of anti-icing before the fluid supply is exhausted.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT. ▲ ▲

The aircraft is equipped with the following communication and radio navigation equipment: Very high frequency (VHF) command transceiver, very high frequency (VHF) stand by transmitter (aircraft ▲ only), very high frequency (VHF) dual omni-directional navigation and receiving system, an ultra-high frequency (UHF) glide slope receiver, a low frequency (LF) automatic directional finder (ADF) receiver, and a marker beacon receiver. Control of all radio equipment may be maintained by either the pilot or copilot.

Note

> No transmission will be made on emergency (distress) frequency channels except for emergency purposes.

AUDIO AMPLIFIER. ▲

The audio outputs of all radio equipment are fed into a single audio amplifier to obtain a uniform speaker operation of all equipment. The amplifier is controlled by an audio amplifier switch (8, figure 4-6) labeled AUDIO AMP and located on the VHF communication control panel. The volume of each piece of radio equipment is controlled by individual volume control knobs which adjust the amount of input to be increased by the audio amplifier. The audio amplifier switch also provides power to the stand by transmitter installed on aircraft ▲.

Note

- The audio amplifier switch must be ON for speaker operation.
- In the event of audio amplifier failure, the phone position on the VHF Communication Control panel is not affected. It is recommended that for solo or IFR operation, the headphones be readily available.

MICROPHONE. ▲ ▲

A noise cancelling microphone (11, figure 1-4) is installed on the forward side of the wing spar. The microphone is conveniently mounted between the front seats to facilitate operation from either the pilot's or copilot's seats. The microphone jack is located on the seat web of the copilot's seat. The headphone jacks are located in each outboard side of the stationary instrument panel.

HEADPHONES. ▲ ▲

A pair of headphones are located on hooks (10, figure 1-17; 9, figure 1-18) outboard of the pilot's and copilot's seats. The headphone jacks are located in each outboard side of the stationary instrument panel.

CABIN SPEAKER. ▲ ▲

A cabin speaker (3, figure 1-17) is mounted under the upholstery in the center of the cabin ceiling directly

COMMUNICATION and Associated ELECTRONIC EQUIPMENT △1 △2

TYPE	DESIGNATION	FUNCTION	OPERATOR	RANGE	LOCATION
VHF Communication	Narco 1016	Two-Way Voice Communication	Pilot or Copilot	Line of Sight	Instrument Panel
Stand By VHF Transmitter	ARC Type T-11B	Stand By VHF Transmitter	Pilot or Copilot	Line of Sight	Instrument Panel
VHF Navigation (Omni System)	ARC Type 15D	Reception of VOR and Voice	Pilot or Copilot	Line of Sight	Instrument Panel
UHF Navigation (Glide Slope System)	Wilcox 700B	Glide Slope Indications	Pilot or Copilot		Instrument Panel
LF Navigation (ADF Radio Compass)	ARC Type 21A	Automatic Direction Finder and LF Receiver	Pilot	Up to 200 Miles	Instrument Panel
Marker Beacon	ARC Type R-20	Receive Marker Beacon Signals	Pilot or Copilot		Instrument Panel

Figure 4-5

above the pilot's and copilot's seats. The speaker is powered by the audio amplifier and control is maintained from switches on the instrument panel.

VHF COMMUNICATIONS SYSTEM. ▲▲

The Narco 1016 VHF transceiver is installed for VHF, simplex, communications. A frequency may be selected and automatically the transmitter and receiver are tuned to the frequency, ready for immediate operation. The transceiver may be tuned to a maximum of 400 channels, within the frequency range of 118.00 to 137.95 megacycles spaced 50 kilocycles apart. The system is provided with a squelch which eliminates irritating background noise during standby periods. Operation of the unit is controlled from the VHF communication control panel (figure 4-6) located on the instrument panel. The only other operating control is the microphone press-to-talk switch. Sidetone output is provided through the headphones and may be used as an indication of transmitter operation.

CAUTION

The NARCO 1016 (VSG-2) primary VHF radio equipment should be OFF whenever an external power source is connected.

Note

If sidetone is heard, transmitter is operating. If no sidetone is heard the transmitter is not operating and another channel should be tried.

On-Off Volume Control Knob. ▲▲

The volume control and ON-OFF switch are included in the one control knob. Turning the ON-OFF volume control knob (11, figure 4-6 clockwise will turn the transceiver ON and increase the volume. The extreme counterclockwise position of the knob is OFF.

Frequency Selector Knob. ▲▲

The frequency selector (12, figure 4-6) is provided to select the channel of operation of the transceiver. The frequency dial is calibrated in megacycles and tenths of megacycles. The megacycles are selected by turning the large knob. Tenths of megacycles may be selected by use of the small lever.

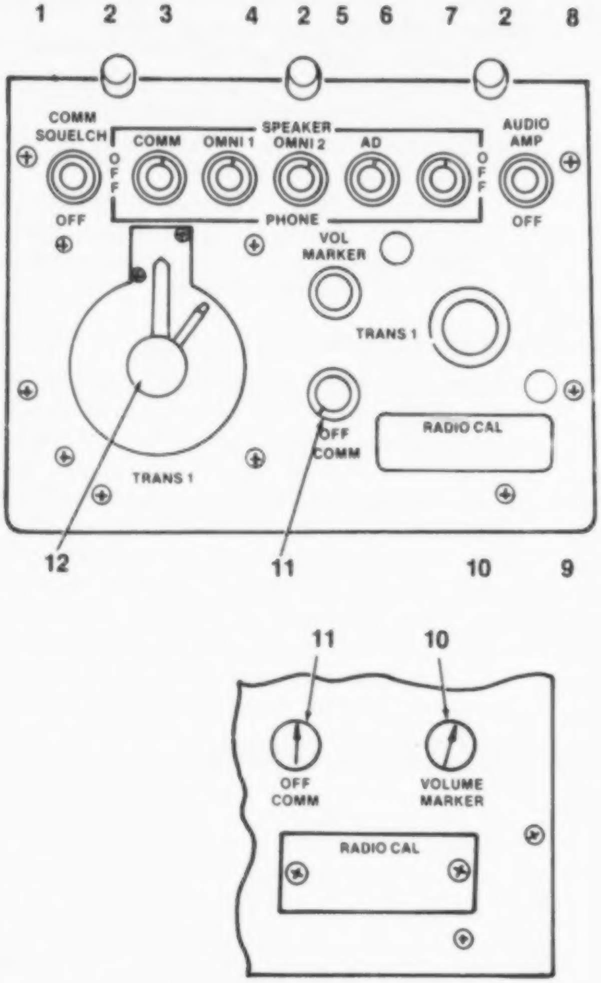
Communication Squelch Switch. ▲▲

The squelch switch labeled COMM SQUELCH (1, figure 4-6) is a momentary switch and may be used to check the operation of the receiver. When the switch is pressed down to the OFF position the receiver background noise may be heard. When the switch is released it returns to the ON position and squelch is applied to the receiver.

Communication Speaker-Phone Switch. . ▲1 ▲2

The speaker-phone switch labeled COMM (3, figure 4-6) selects the type of audio circuit desired for listening. When the switch is placed in the PHONE position, reception may be heard through the headset. When the switch is placed in the SPEAKER position the output is fed into the audio amplifier for speaker operation. The volume level may be adjusted by the ON-

VHF COMMUNICATIONS CONTROL PANEL ▲1 ▲2



1. Communication Squelch Switch
2. Control Panel Lights
3. Communication Speaker-Phone Switch
4. Omni 1 Speaker-Phone Switch
5. Omni 2 Speaker-Phone Switch
6. ADF Speaker-Phone Switch
7. Marker Beacon Speaker-Phone Switch
8. Audio Amplifier Switch
9. Stand By Transmitter Selector Switch ▲2
10. Marker Beacon Volume Control Knob
11. Communication ON-OFF Volume Control Knob
12. Frequency Selector

Figure 4-6

OFF volume control knob for either type of operation.

Operation of VHF Communication System. ▲1 ▲2

Operation of the VHF communication system may be accomplished according to the following steps.

1. ON-OFF volume control knob — ON.
2. COMM speaker phone switch — ON (for speaker operation).
4. Frequency selector — To desired frequency.

Note

On aircraft ▲2 it is necessary to place the stand by transmitter selector switch (9, figure 4-6) in the TRANS 1 position before the Narco 1016 transmitter will operate.

5. ON-OFF volume control knob — Adjust for comfortable listening level.
6. Microphone switch — Depress to transmit.

Note

Allow set to warm up for at least two minutes before attempting transmission. In the event the battery does not provide adequate voltage, operate an engine at sufficient rpm to show a positive indication on the ammeter.

7. Squelch switch —Depress and listen for background noise to test operation of receiver.
8. ON-OFF volume control knob — Rotate full counterclockwise (to turn receiver off).

STAND BY VHF TRANSMITTER. ▲

An ARC type T-11B VHF transmitter is installed as a stand by facility. The operation of the transmitter is controlled by a stand by transmitter selector switch (9, figure 4-6) and the ON-OFF switch (8, figure 4-6) for the audio amplifier. Power for the stand by transmitter is obtained from the audio amplifier power supply. VHF reception may be obtained from either VHF navigation receiver or the Narco 1016 transceiver when stand by operation is desired.

Stand By Transmitter Selector Switch. ▲

Microphone switching and transmitter frequency selection is controlled by the transmitter selector switch (9, figure 4-6). When the switch is in the Trans 1 position the stand by transmitter is inoperative and VHF communications are transferred to the Narco 1016 transceiver. With the switch placed in a frequency position the stand by transmitter is operative and the transmitter portion of the Narco transceiver is disabled.

Operation of Stand By VHF Transmitter. ▲

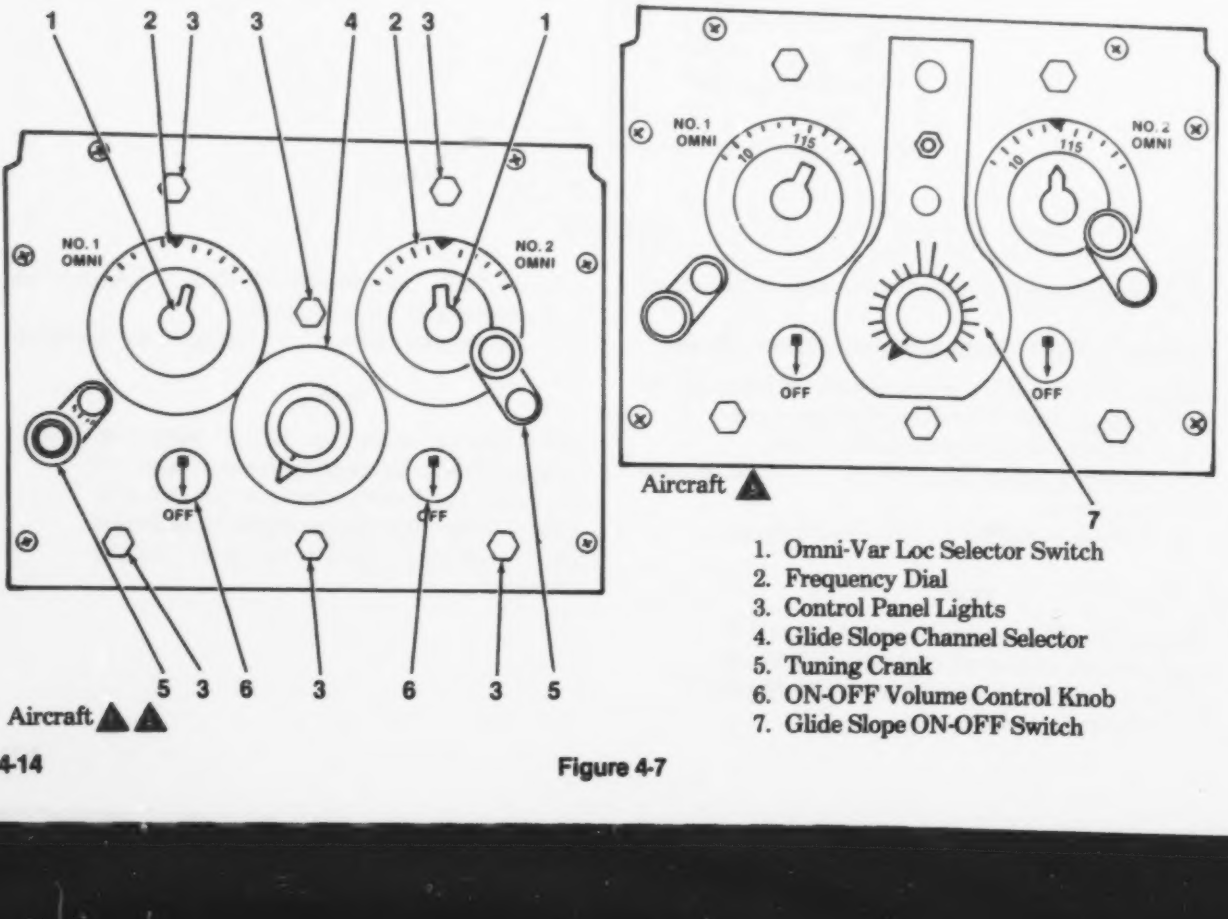
Operation of the stand by transmitter may be accomplished according to the following steps:

1. AUDIO AMP switch—ON.
2. Stand by transmitter frequency selector switch—To desired transmitting frequency.
3. Operate either VHF navigation or Narco 1016 transceiver system to receive.
4. Microphone Switch—Depress to transmit.
5. To return communication to Narco transceiver rotate stand by transmitter frequency selector switch to TRANS 1 position.

VHF NAVIGATION SYSTEM. ▲ ▲

An ARC type 15D dual VOR navigation system is installed in the aircraft. The system may be used for flying desired courses on a VOR station, for obtaining a precise fix on two or more VOR stations, and for making ILS approaches. Visual signals are presented on two course indicators located on the left side of the instrument panel. Course information is presented on both the upper and lower course indicators, whereas the glide slope indicator is operative only on the upper indicator. Operation of the VOR receivers is controlled from the VHF navigation control panel (figure 4-7) located on

VHF NAVIGATION CONTROL PANEL ▲▲



1. Omni-Var Loc Selector Switch
2. Frequency Dial
3. Control Panel Lights
4. Glide Slope Channel Selector
5. Tuning Crank
6. ON-OFF Volume Control Knob
7. Glide Slope ON-OFF Switch

Figure 4-7

the instrument panel. It contains dual ON-OFF volume controls knobs, frequency dials, tuning cranks, and Omni-Var Loc Selector Switches.

On-Off Volume Control Knob. ▲ ▲

An ON-OFF volume control knob (6, figure 4-7) is provided for each VOR receiver. Turning the knobs clockwise will turn the receivers ON and increase the volume. Either receiver may be operated separately or both may be operated simultaneously. The No. 1 OMNI ON-OF volume control knob also controls the power to the marker beacon receiving system. This control must be turned on for marker beacon receiver operation.

Omni-Var Loc Selector Switch. ▲ ▲

The omni-var loc selector switch (1, figure 4-7), has two positions labeled OMNI and VAR LOC. The switch permits selection of either type of navigation signals desired. When the switch is in the OMNI position and a VOR station is tuned in, the magnetic bearing to or from the station can be read under the course pointer of the course indicator with the course deviation indicator centered. When the switch is in the VAR LOC position and an ILS station is tuned in, a right, left or centered indication will appear depending on the aircraft's position in relation to the localizer.

Tuning Crank. ▲ ▲

The tuning crank (5, figure 4-7) allows selection of the receiver frequency. The frequency dial (2, figure 4-7) indicates the frequency selected with the tuning crank. The receivers are continuously tunable through the frequency range of 108 to 135 megacycles. Frequencies from 108 to 118 megacycles cover the VOR and ILS facilities.

Omni 1 and Omni 2 Speaker-Phone Switches. ▲ ▲

The speaker-phone switches, labeled Omni 1 and Omni 2 (4 and 5, figure 4-6) select the type of audio circuit desired for listening. When the switches are placed in the PHONE position, reception may be heard through the headset. When the switch is placed in the SPEAKER position the output is fed into the audio amplifier for speaker operation. The volume level may be adjusted by the ON-OFF volume control knob for either type of operation.

Course Indicators. ▲ ▲

Two course indicators (figure 4-8) are installed on the left side of the instrument panel. Each course indicator contains a course deviation indicator (CDI) (vertical bar), glide slope indicator (GSI) (horizontal bar), to-from indicator, course set knob, course pointer (arrow) and reciprocal course pointer (dot), 360° course selector scale, and red warning flags for the course deviation indicator and glide slope indicator. The warning flaps indicate whether the receiver signal is of sufficient strength to be used for navigational purposes. The upper course indicator is connected to the NO 1 OMNI receiver and the glide slope receiver. The lower course indicator is connected to the NO 2 OMNI receiver. The glide slope indicator of the lower course indicator is not operative.

COURSE INDICATOR

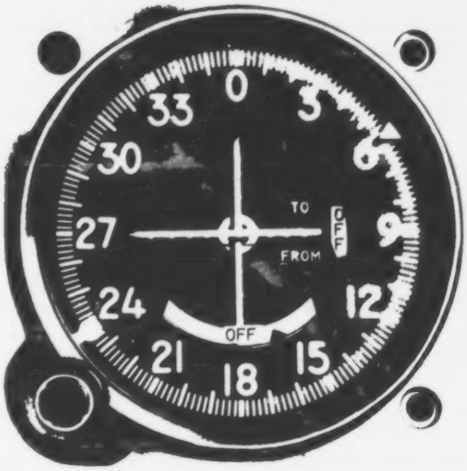


Figure 4-8

Operation of VHF Navigation System On VOR (OMNI) Range. ▲ ▲

1. ON-OFF volume control knob — ON.
2. OMNI-VAR LOC selector switch — OMNI position.
3. Tuning Crank — Tune desired station. (Flag on course deviation indicator will disappear when station is tuned in properly. If flag does not disappear, signal strength of station is not sufficient for navigational purposes.)

CAUTION

Whenever the NARCO 1016 and the OMNI receivers are tuned within 13 megacycles of each other, both OMNI's will become inoperative if the NARCO is keyed for transmission. If this condition exists, do not transmit during critical phases of flight. The NARCO 1016 Transceiver does not affect the Localizer or Glide Slope part of the ILS System.

Note

Visual indications are independent of audio circuits and are not affected by the volume level. The volume level should be high enough to identify the station.

4. ON-OFF volume control knob — Adjust for comfortable listening level.
5. Course indicator — Select desired course to or from the station by setting the course pointer on the desired course with the course set knob.
6. Observe the deflection of the course deviation indicator to intercept and maintain the selected course (See COURSE INTERCEPTION PROCEDURES this Section).
7. ON-OFF volume control knob — Rotate full counterclockwise (to turn equipment off).

Glide Slope Channel Selector. ▲ ▲

The channel selector (4, figure 4-7) for the glide slope receiver is a rotary type switch with frequency tabs placed at each index position. The extreme counterclockwise position of the selector is OFF. Ten addiional clockwise positions or twenty positions ▲ are provided for glide slope channel.

Glide Slope Indicator. ▲▲

The visual signal for the glide slope is presented only on the NO 1 OMNI course indicator. The glide slope ndicator (horizontal bar) will indicate whether the aircraft is above, below or on the glide slope. A red warning flag will be in view when the signal received s of insufficient strength to be reliable or when the receiver is turned off.

GLIDE-SLOPE RECEIVER SYSTEM. ▲ ▲

This set is used in conjunction with the localizer portion of the VOR-1 navigation system. The glide slope receiver controls are located on the VHF navigational panel (figure 4-7).

Operation of Glide Slope Receiver System ▲ ▲

1. Turn the ON-OFF volume control knob on the VOR-1 control panel ON.
2. Glide slope switch - ON. ▲
3. Select the localizer frequency to be used.
4. Observe glide slope indicators for proper operation and warning flag out of view.
5. Turn the ON-OFF volume control knob on the VOR-1 control panel full counterclockwise to turn system off.
6. Glide slope switch - OFF. ▲

NOTE

> If the No. 1 VOR receiver is non-operational (localizer portion also non-operational), it is still possible to fly a precision ILS approach by selecting the appropriate localizer frequency on the No. 2 VOR receiver and reading azimuth information on the No. 2 indicator. Glide slope information would still be read on the No. 1 indicator.

MARKER BEACON RECEIVING SYSTEM. ▲ ▲

The aircraft is equipped with an ARC type R-20A marker beacon receiver. The receiver provides visual and aural indication when the aircraft passes over a marker beacon transmitter station. The marker beacon receiving system obtains power for operation from the NO 1 OMNI navigation system. The NO 1 OMNI receiver must be turned ON before the marker beacon receiver will operate. The marker beacon receiver requires no tuning and only adjustment of the NO 1 OMNI ON-OFF volume control knob, marker beacon volume control knob and speaker-phone switch are required for operation of the system.

Volume Control Knob. ▲ ▲

A volume control knob labeled VOL Marker (10, figure 4-6) is located on the VHF communications control panel. Clockwise rotation of the volume control knob increases the volume.

Marker Beacon Speaker-Phone Switch. ▲ ▲

The speaker-phone switch, labeled MKR, (7, figure 4-6) selects the type of audio circuit desired for listening. When the switch is placed in the PHONE position, reception may be heard on the headsets. When the switch is placed in the SPEAKER position, the output is fed into the audio amplifier for speaker operation.

Marker Beacon Indicator Light. ▲ ▲

A marker beacon indicator light (2, figure 1-24), labeled Marker is located on the left side of the instrument panel. The light provides a signal when the aircraft passes over a marker beacon transmitter.

Operation of the Marker Beacon System. ▲ ▲

1. NO 1 OMNI ON-OFF volume control knob—ON. This knob has no effect upon the volume of the marker beacon signal.
2. Marker beacon volume control knob — Rotate clockwise until the beacon signal is received, adjust volume to comfortable level.
3. NO 1 OMNI ON-OFF volume control knob — Rotate full counterclockwise (to turn both receivers off).

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT. ▲

The aircraft is equipped with the following communication and radio navigation equipment: very high frequency (VHF) command transceiver, very high frequency (VHF) stand-by transmitter, very high frequency VHF dual omni-directional navigation and receiving system, an ultra-high frequency (UHF) glide slope receiver, a low frequency (LF) automatic direction finder (ADF) receiver, a marker beacon receiver and a very high frequency (VHF) stand-by receiver. Control of all radio equipment may be maintained by either the pilot or copilot.

AUDIO AMPLIFIER. ▲

The audio output of all radio equipment are fed into a single audio amplifier to obtain a uniform speaker operation of all equipment. The amplifier is controlled by an audio amplifier switch (10, figure 4-10) labeled SPKR AMP and located on the marker beacon and switch control panel. The volume of each piece of radio equipment is controlled by individual volume control knobs which adjust the amount of input to be increased by the audio amplifier.

Note

> The audio amplifier switch must be ON for speaker operation.

MICROPHONE. ▲

A noise cancelling microphone (11, figure 1-4) is installed on the forward side of the front wing spar. The microphone is conveniently mounted between the front seats to facilitate operation from either the pilot's

COMMUNICATION and Associated ELECTRONIC EQUIPMENT ▲

TYPE	DESIGNATION	FUNCTION	OPERATOR	RANGE	LOCATION
VHF Communication	ARC Type 210B	Two-Way Voice Communication	Pilot or Copilot	Line of Sight	Instrument Panel
Stand By VHF Transmitter	ARC Type T-20	Stand By VHF Transmitter	Pilot or Copilot	Line of Sight	Instrument Panel
Stand By VHF Receiver	ARC Type R-19	Stand By VHF Receiver	Pilot or Copilot	Line of Sight	Instrument Panel
VHF Navigation (Omni System)	ARC Type 15F	Reception of VOR and Voice	Pilot or Copilot	Line of Sight	Instrument Panel
UHF Navigation (Glide Slope System)	ARC Type R-31A	Glide Slope Indications	Pilot or Copilot		Instrument Panel
LF Navigation (ADF Radio Compass)	ARC Type 21A	Automatic Direction Finder and LF Receiver	Pilot	Up to 200 Miles	Instrument Panel
Marker Beacon	ARC Type R-20B	Receive Marker Beacon Signals	Pilots or Copilot		Instrument Panel

Figure 4-9

or copilot's seats. The microphone jack is located on the seat web of the copilot's seat.

HEADPHONES. ▲

A pair of headphones is located on hooks (10, figure 1-17; 9, figure 1-18) outboard of the pilot's and copilot's seats. The headphone jacks are located in each outboard side of the stationary instrument panel.

CABIN SPEAKER. ▲

A cabin speaker (3, figure 1-17) is mounted under the upholstery in the center of the cabin ceiling directly above the pilot's and copilot's seats. The speaker is powered by the audio amplifier and control is maintained from switches on the marker beacon and switch control panel.

VHF COMMUNICATION SYSTEM. ▲

The ARC type 210B VHF communication system is installed for VHF simplex, communication. The sysstem is electrically tuned and crystal controlled, and covers the frequency range of 118.00 to 137.95 megacycles in 50 kilocycles steps to provide a total of 400 channels. Two modes of operation are available. Single-channel simplex (SCS), during which the transmitter and receiver operates on the same frequency, and double-channel simplex (DCS), during which the transmitter operates 6.0 megacycles above the receiver frequency. The control panel (figure 4-11) on the instrument panel incorporates, an ON-OFF volume control knob, frequency indicator window and selector knobs, and a mode-of-operation knob. The system receives power from the 28 volt dc bus and is protected by a push-to-reset type circuit breaker (15, figure 1-21).

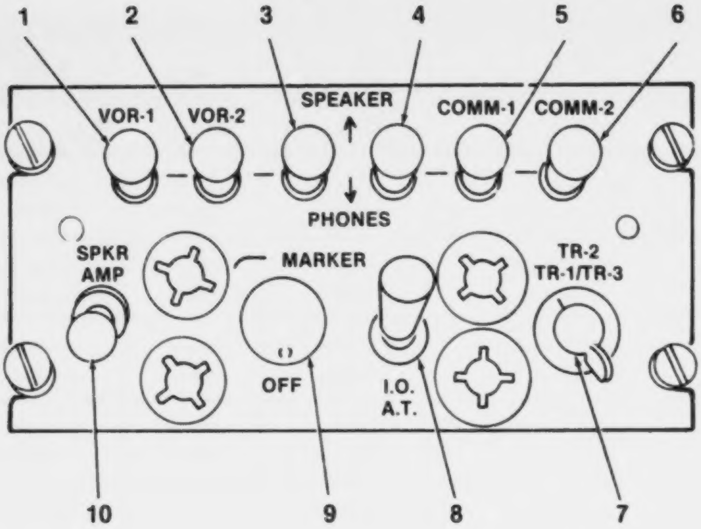
On-Off Volume Control Knob. ▲

The ON-OFF volume control knob (1, figure 4-11), controls receiver audio level and is also used as the power ON-OFF switch. Clockwise rotation of the control knob from the OFF position applies power to the equipment and places the transceiver in the receive condition. The transceiver is placed in the transmit condition when the microphone switch is closed. Further clockwise rotation increases the audio level of the receiver.

Frequency Selector Knobs. ▲

Two frequency selector knobs (4, 5, figure 4-11) are provided on the control panel and provides a manual means for tuning the communication system to the desired operating frequency as shown in the frequency indicator window. The left hand knob sets up the whole megacycles of the desired frequency and the right hand knob gives the tenths of a megacycle of the

MARKER BEACON AND SWITCH CONTROL PANEL ▲



1. VOR-1 Speaker-Phone Switch
2. VOR-2 Speaker-Phone Switch
3. ADF Speaker-Phone Switch
4. Marker Beacon Speaker-Phone Switch
5. Comm.-1 Speaker-Phone Switch
6. Comm.-2 Speaker-Phone Switch
7. Transmitter Selector Switch
8. Marker Beacon Altitude Sensitivity Switch
9. Marker Beacon ON-OFF Volume Control Knob
10. Audio Amplifier Switch

Figure 4-10

desired frequency. Any frequency between 118.00 and 137.95 megacycle may be selected. The frequency selector knobs may be rotated either clockwise or counterclockwise.

SCS-DCS Switch. ▲

The SCS-DCS switch (3, figure 4-11) on the control panel selects the mode of operation. When the switch is in the SCS (single channel simplex) positions, the transceiver receives and transmits on the frequency indicated in the frfequency indicator window. When the switch is in the DCS (double-channel simplex) position the transceiver receives on the frequency indicated in the frequency indicator window and transmits on a frequency 6.0 megacycles above the receiving frequency. (For example: With the frequency indicator window indicating 120.70 megacycles and the switch set to DCS position, the transceiver will receive on 120.70 megacycles and the transceiver will transmit on 126.70 megacycles).

Comm-1 Speaker-Phone Switch. ▲

The speaker-phone switch (5, figure 4-10) labeled COMM-1 selects the type of audio circuit desired for listening. When the switch is placed in the PHONE position, reception may be heard through the headset. When the switch is placed in the SPEAKER position, the output is fed into the audio amplifier for speaker operation. The volume level may be adjusted by the ON-OFF volume control knob for either type operation.

Transmitter Selector Switch. ▲

Microphone switching is controlled by the transmitter selector switch (7, figure 4-10) labeled TR-1, TR-2 and TR-3. When the switch is in the TR-1 position the standby transmitter is inoperative and VHF transmission is transferred to the ARC Type 210B transceiver. With the switch in the TR-2 position the standby transmitter is operative and the ARC Type 210B is disabled. The TR-3 position is not used on the aircraft. Simultaneous reception is possible by placing both the COMM-1 and COMM-2 Speaker-Phone Switches to SPEAKER or PHONE. The Transmitter Selector switch does not affect the receiver functions.

Operation of VHF Communication System. ▲

1. Transmitter selector switch—TR-1 position.
2. Turn the ON-OFF volume control knob ON—Allow equipment to warm-up.
3. COMM-1 speaker-phone switch—As desired.
4. Audio amplifier switch—ON (for speaker operation).
5. SCS-DCS switch—Set to desired mode of operation.
6. Select desired frequency.

Note

If the DCS mode of operation is used, the frequency indicator window will indicate the frequency to which the receiver is tuned.

The transmitter will automatically operate 6.0 megacycles above the indicated receiver frequency.

7. ON-OFF volume control knob—Adjust for comfortable listening.
8. Microphone switch—Depress to transmit.
9. Microphone switch—Release to receive.
10. Turn the ON-OFF volume control knob full counterclockwise to turn system off.

STANDBY VHF COMMUNICATION SYSTEM.▲

An ARC Type T-20 transmitter and ARC type R-19 receiver are installed as a standby facility and provides two-way communication between aircraft to ground stations. The operation of the standby system is controlled by a control panel (figure 4-12) located on the right switch and control panel. The system is manually tuned and crystal controlled, and covers the frequency range of 118.00 to 148.00 megacycles with the transmitter operating on twenty preset channels. The control panel incorporates an ON-OFF volume control knob, tuning crank, Frequency dial and a transmitter channel selector switch. The system receives power from the 28 volt dc bus and is protected by a push-to-reset type circuit breaker (3, figure 1-21).

On-Off Volume Control Knob.▲

The ON-OFF volume control knob (3, figure 4-12), controls receiver audio level and is also used as the power ON-OFF switch. Clockwise rotation of the control knob from the OFF position applies power to the equipment and places the receiver in the receive condition. The transmitter is placed in the transmit condition when the microphone switch is closed. Further clockwise rotation increases the audio level of the receiver.

Tuning Crank.▲

The tuning crank (4, figure 4-12) labeled PRESS-TO WHISTLE turns the frequency dial (1, figure 4-12) labeled REC, and also operates a mechanical linkage that is connected to the receiver, which permits the receiver to be tuned to any desired frequency as indicated on the frequency dial. The crank also provides a means of setting the receiver precisely to the frequency selected on the transmitter. By pressing in on the crank while turning, a "whistle through" sound will indicate that the receiver is tuned to the same frequency as the transmitter. The receiver is continuously tunable through the frequency range of 118.00 to 148.00 megacycles.

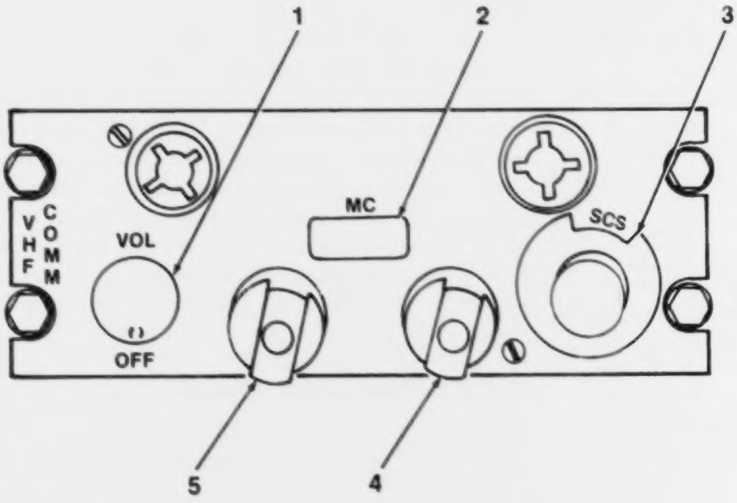
Transmitter Channel Selector Switch.▲

The transmitter channel selector switch (2, figure 4-12) labeled TRANS selects the desired transmitting frequency of the transmitter.

Comm-2 Speaker-Phone Switch.▲

The speaker-phone switch (6, figure 4-10) labeled COMM-2, selects the type of audio circuit desired for

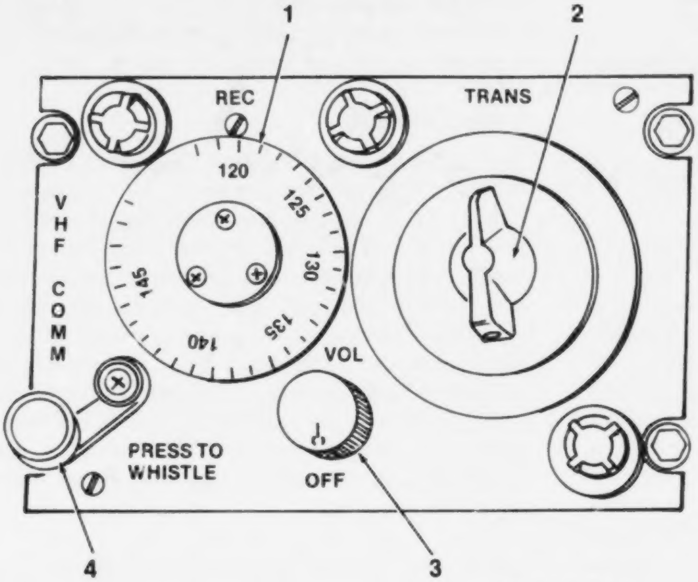
VHF COMMUNICATION CONTROL PANEL▲



1. ON-OFF Volume Control Knob
2. Frequency Indicator Window
3. SCS-DCS Switch
4. Tenth Megacycle Frequency Selector Knobs
5. Whole Megacycle Frequency Selector Knobs

Figure 4-11

STANDBY VHF COMMUNICATION CONTROL PANEL ▲



1. Receiver Frequency Dial
2. Transmitter Channel Selector Switch
3. ON-OFF Volume Control Knob
4. Turning Crank

Figure 4-12

listening. When the switch is placed in the PHONE position reception may be heard through the headset. When the switch is placed in the SPEAKER position the output is fed into the audio amplifier for speaker operation. The volume level may be adjusted by the ON-OFF volume control knob for either type of operation.

Operation of Standby VHF Communication System. ▲

1. Transmitter selector switch—TR-2 position.
2. Turn the ON-OFF volume control knob ON—Allow equipment to warm up.
3. COMM-2 Speaker-phone Switch—As desired.
4. Audio amplifier switch—ON (for speaker operation).
5. Turn the transmitter channel selector switch to an assigned channel.
6. Tuning crank—Press, turn until the whistle is loudest

Note

> If the receiving and transmitting frequencies are to be the same, select the transmitting channel first, then depress and adjust the tuning crank for maximum whistle.

7. ON-OFF volume control knob—Adjust for comfortable listening.
8. Microphone switch—Depress to transmit.
9. Microphone switch—Release to receive.
10. Turn the ON-OFF volume control knob full counterclockwise to turn system off.

VHF NAVIGATION SYSTEM. ▲

The ARC Type 15F dual radio set provides reception and steering information utilizing VHF radio frequencies. Each set has 190 channel selections covering a frequency range of 108.00 through 126.90 megacycles. The control panels (figure 4-13) on the instrument panel incorporates on-off volume control knobs, frequency indicators and selector knobs and squelch control knobs. VOR and localizer readings are presented on the course deviation indicator (CDI) (vertical needle) of both course indicators located on the left side of the instrument panel. The VOR-1 (top control panel) also selects, automatically and simultaneously the correct glide slope frequency for the selected ILS frequency which is presented on the glide slope indicator (GSI) (horizontal needle) of both course indicators. This set receives power from the 28 volt dc bus and is protected by push-to-rest type circuit breakers (2, 31, figure 1-21).

On-Off Volume Control Knob. ▲

An ON-OFF volume control knob (1, figure 4-13) is provided on each control panel. Turning the knobs clockwise will turn the receivers on and increase the volume. Counterclockwise rotation of the knobs is OFF. Either receiver may be operated separately or both may be operated simultaneously.

Frequency Selector Knobs. ▲

Two frequency selector knobs (2, 3, figure 4-13) are provided on each control panel and provides a manual means for tuning the omni-range equipment to the desired operating frequency as shown in the frequency indicator window. The left hand knob sets up the whole megacycles of the desired frequency and the right hand knob gives the tenths of a megacycle of the desired frequency. Any frequency between 108.00 and 126.90 megacycles may be selected. The frequency selector knobs may be rotated either clockwise or counterclockwise: All odd-tenth- megacycle frequencies, beginning with 108.10 megacycle and ending with 111.90 megacycles are localizer frequencies. All even-tenth-megacycle frequencies, beginning with 108.20 megacycles and ending with 112.00 megacycles, are VOR frequencies. The remaining frequencies, from 112.10 to 117.90 megacycles, both odd and even tenths, are assigned to VOR facilities only. The glide slope frequency band is divided into four frequency groups related to the 108-, 109-, 110-, and 111- megacycles localizer bands.

Note

Only the VOR-1 (top control panel) permits the simultaneous and automatic selections of the correct glide slope frequency with the selected localizer frequency.

Squelch Control Knob. ▲

When the squelch control knob (5, figure 4-13) located on each control panel is placed in the OFF position (maximum counterclockwise rotation) the receiver squelch circuit is disabled and the receiver is awake. The degree of clockwise rotation determines the receiver squelch threshold level.

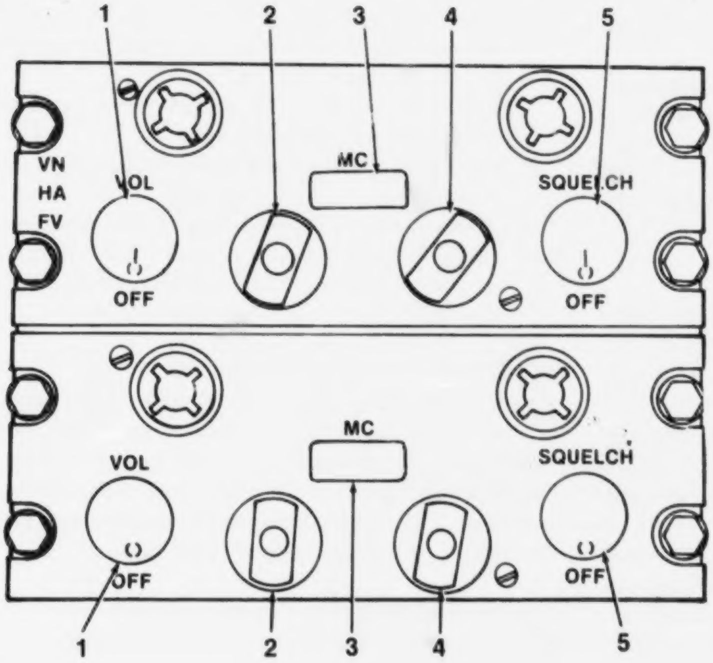
VOR-1 and VOR-2 Speaker Phone Switches. ▲

The speaker-phone switches (1, 2, figure 4-10), labeled VOR-1 and VOR-2 select the type of audio circuit desired for listening. When the switches are placed in the PHONE position, reception may be heard through the headset. When the switches are placed in the SPEAKER position, the output is fed into the audio amplifier for speaker operation. The volume level may be adjusted by the ON-OFF volume control knob for either type of operation.

Course Indicators. ▲

Two course indicators (figure 4-8 are installed on the

VHF NAVIGATION CONTROL PANELS ▲



1. ON-OFF Volume Control Knob
2. Whole Megacycle Frequency Selector Knob
3. Frequency Indicator Window
4. Tenth Megacycle Frequency Selector Knob
5. Squelch Control Knob

Figure 4-13

left side of the instrument panel. They are the same type as installed in aircraft ▲ and ▲ and their components are the same. The upper course indicator is connected to the VOR-1 receiver and the lower indicator to the VOR-2 receiver. The glide slope indicators of both course indicators are connected to the glide slope receiver and operate when the VOR-1 receiver is tuned to an ILS frequency.

Glide Slope Indicator. ▲

The visual signals for the glide slope is presented on both course indicators. The glide slope indicator (horizontal bar) will indicate whether the aircraft is above, below, or on the glide slope. A red warning flag will be in view when the VOR-1 receiver is not tuned to an ILS frequency or is off and when the signal received is of insufficient strength to be reliable.

Operation of VHF Navigation System. ▲

1. Turn the ON-OFF volume control knob ON. Allow equipment to warm up.
2. Select desired frequency.
3. ON-OFF volume control knob — Adjust for comfortable listening level.
4. VOR-1 and VOR-2 speaker phone switch — SPEAKER or PHONE as desired.

Note

Visual indications are independent of audio circuits and are not affected by the volume level. The volume level should be high enough to identify the station.

5. Course indicator — Select desired course to or from the station.
6. Observe the deflection of the course deviation indicator to intercept and maintain the selected course. (See COURSE INTERCEPTION PROCEDURES this Section).
7. Turn the ON-OFF volume control knob full counterclockwise to turn system off.

COURSE INTERCEPTION PROCEDURES.

To intercept a course you must first determine the radial of the station selected that the aircraft is on. To do this rotate the course selector knob until the course deviation indicator centers with a to-on the to-from indicator. The course pointer will then indicate the magnetic bearing to the station and the reciprocal course pointer which is 180 degrees from the course pointer indicates the radial.

The information on the course selector scale with the CDI centered is the same as presented by a VOR bearing indicator on a standard Air Force RMI Card. Therefore it can be used in the same way to determine the intercept heading of a desired course. (Reference AFM 51-37 Chapter 10)

Inbound.

1. Maintain present heading.
2. Center the CDI with a To indication on the to-from Indicator and leave centered.
3. Locate the desired inbound course on the course selector scale.
4. Proceed from the desired inbound course along the scale in the nearest direction to the course pointer, then continue in the same direction beyond the course pointer (normally 30 degrees) and read the intercept heading.
5. Turn the aircraft in the nearest direction to and maintain the intercept heading.
6. Reset the course pointer to the desired inbound course.
7. When within 10 degrees of the selected course the CDI will start to move toward center. Interpret its rate of movement to determine the lead point to start the turn to roll out on course.

Outbound.

1. Maintain present heading.
2. Center the CDI with a From indication on the to-from indicator and leave centered. (The course pointer will then indicate the radial the aicarft is presently on.)
3. Locate the course pointer of the course set marker on the course selector scale.
4. Proceed from the course pointer along the scale in the nearest direction to the desired outbound course, then continue in the same direction beyond the desired outbound course (normally 45 degrees) and read the intercept heading.
5. Turn the aircraft in the nearest direction to and maintain the intercept heading.
6. Reset the course pointer to the desired outbound course.
7. When within 10 degrees of the selected course the CDI will start to move toward center. Interpret its rate of movement to determine the lead point to start the turn to roll out on course.

GLIDE-SLOPE RECEIVER SYSTEM. ▲

This set is used in conjunction with the localizer portion of the VOR-1 navigation system. Visual glide slope indications are presented on both course indicators (figure 4-8) by means of the glide slope indicator (horizontal bar). The glide slope receiver is controlled from the VOR-1 navigation control panel (figure 4-13).

Operation of Glide Slope Receiver System. ▲

1. Turn the ON-OFF volume control knob on the

VOR-1 control panel ON.

2. Select the localizer frequency to be used.
3. Observe glide slope indicators for proper operation and warning flat out of view.
4. Turn the ON-OFF volume control knob on the VOR-1 control panel full counterclockwise to turn system off.

MARKER BEACON RECEIVING SYSTEM. ▲

The aircraft is equipped with an ARC Type R-20B marker beacon receiver. The receiver provides visual and aural indication when the aircraft passes over a marker beacon transmitter station. The marker beacon receiver system obtains power for operation from the VOR-1 navigation system. The VOR-1 receiver must be turned ON before the marker beacon ON-OFF volume control knob will turn the marker beacon receiver ON. The marker beacon system also is provided with a high and low altitude sensitivity switch. The system receives 28 volt dc power from the 28 volt dc bus and is protected by a push-to-reset type circuit breaker (2, figure 1-21).

Marker Beacon Indicator Light. ▲

A marker beacon indicator light (2, figure 1-24) labeled MARKER is located on the left side of the instrument panel. The light provides a signal when the aircraft passes over a marker beacon transmitter.

On-Off Volume Control Knob. ▲

The ON-OFF volume control know (9, figure 4-10) sets the marker beacon receiver in operation and controls the audio level of the received signal. Clockwise rotation of the knob increases the audio level and counterclockwise rotation decreases the audio level and turns the system OFF.

Note

> The VOR-1 ON-OFF volume control knob (1, figure 4-13) must be turned ON to supply marker beacon power.

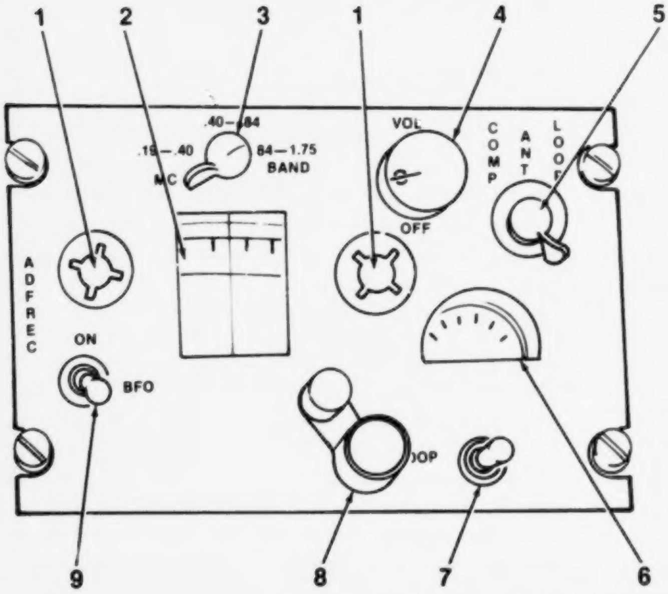
Altitude Sensitivity Switch. ▲

The altitude sensitivity switch (8, figure 4-10) labeled HIGH ALT and LOW ALT provides a means for increasing the sensitivity of the receiver when flying at high altitudes. With the switch in the HIGH ALT position the receiver can pick up weak station signals, when flying at high altitudes, and amplifies the signal so as to provide a visual and audio indication. When flying at low altitudes where station signals are strong the extra sensitivity is not required, the switch should be placed in the LOW ALT position.

Marker Beacon Speaker-Phone Switch. ▲

The marker beacon speaker-phone switch (4, figure 4-10) selects the type of audio circuit desired for listen-

LF NAVIGATION CONTROL PANEL



1. Control Panel Lights
2. Frequency Dial
3. Band Selector Switch
4. ON-OFF Volume Control Knob
5. Function Selector Switch
6. Tuning Meter
7. Loop Switch
8. Tuning Crank
9. Beat Frequency Oscillator Switch

Figure 4-14

ing. When the switch is placed in the PHONE position, reception may be heard in the headset. When the switch is placed in the SPEAKER position, the output is fed into the audio amplifier for speaker operation.

Operation of Marker Beacon System. ⚠

1. Turn the VOR-1 ON-OFF volume control knob ON.
2. Turn the marker beacon ON-OFF volume control knob ON. Allow equipment to warmup.
3. Altitude sensitivity switch—As required.
4. ON-OFF volume control knob—Adjust, when beacon signal is received to comfortable level.
5. Turn the ON-OFF volume control knob full counterclockwise to turn system off.

LF NAVIGATION SYSTEM.

An ARC Type 21A Automatic Direction Finder is provided for LF navigation. The receiver may be used as a range receiver or as a direction finder within the frequency range of 190 to 1750 kilocycles. The frequency range is covered in three separate bands which may be selected on the LF navigation control panel (figure 4-14). The operation of the direction finding loop is either automatic or may be rotated or stopped by controlling a loop switch.

On-Off Volume Control Knob.

The volume control knob (4, figure 4-14) is labeled VOL. Turning the knob clockwise will turn the receiver ON and increase the volume. Counterclockwise rotation of the knob is OFF.

Band Selector Switch.

The desired frequency range may be selected by the band selector switch (3, figure 4-14). As the switch is changed from one position to another the frequency range will appear on the frequency dial (2, figure 4-14).

Tuning Crank.

A particular frequency on any of the three bands may be selected by the tuning crank (8, figure 4-14). The low frequency radio range stations may be received on the 190 to 400 kilocycle band. Commercial radio stations may be received on the two other bands.

Tuning Meter.

A tuning meter (6, figure 4-14) is located on the LF navigation control panel. The meter will indicate the strength of the received station and is used to tune for maximum signal strength.

Note

> The tuning meter functions only when the function selector switch is in the COMP (compass) position.

Function Selector Switch.

The function selector switch (5, figure 4-14) selects the type of operation desired for the receiver. In the COMP position the receiver will operate as an automatic direction finder. In the ANT position the system will operate as an LF receiver. When the function selector switch is placed in the LOOP position the system will operate as a direction finder and the loop will not turn until the LOOP switch is actuated either to the left or right.

RADIO COMPASS INDICATOR

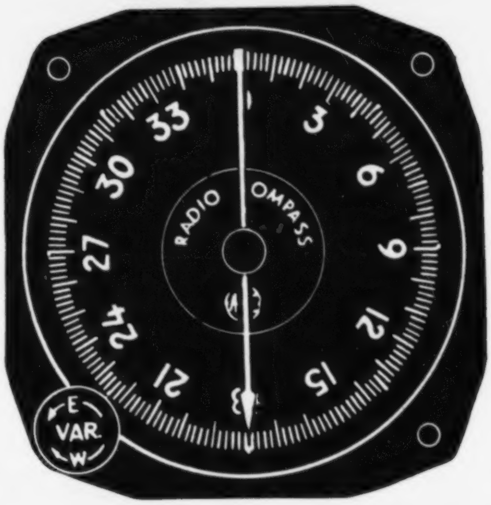


Figure 4-15

Loop Switch.

The loop switch (7, figure 4-14) is a momentary toggle switch which is operated either to the left or right of the center position. The loop may be rotated away from a directional indication with this switch to test the operation of the loop or to set the loop to a desired azimuth depending upon the setting of the function selector switch.

ADF Speaker-Phone Switch.

The speaker-phone switch labeled ADF, (3, figure 4-10; 6, figure 4-6) selects the type of audio circuit desired for listening. When the switch is placed in the PHONE position, reception may be heard on the headset. When the switch is placed in the SPEAKER position, the output is fed into the audio amplifier for speaker operation. The volume level may be adjusted by the ON-OFF volume control knob for either type of operation.

Beat Frequency Oscillator Switch (BFO).

The BFO switch (9, figure 4-14) activates an oscillator to provide a tone to be heard when ever a weak station is tuned in. The tone may be used to tune a station in properly even though the station is too weak to hear intelligibly or to operate the tuning meter. The BFO switch may be turned on and the station tuned in until the tone disappears. For precise tuning the tone should come back in on each side of the station frequency. By rocking the tuning crank, a station may be tuned accurately.

Radio Compass Indicator.

The radio compass indicator (figure 4-15) is located on the extreme left side of the instrument panel. The instrument is synchro-driven by the ADF receiver and will indicate the azimuth of a received station. The indicator is equipped with a knob marker VAR which rotates the indicator scale. The head of the ADF bearing indicator will indicate the magnetic bearing to the station when the heading of the aircraft is set under the top index.

Operation of LF Navigation System.

As a Low Frequency Radio System.

1. ON-OFF volume control knob — ON.
2. Function selector switch — ANT position.
3. Band selector switch — Desired frequency range.
4. Tuning crank — Desired station frequency.
5. ON-OFF volume control knob — Readjust for comfortable level.

Note

Operate receiver with volume advanced only far enough to hear the signal clearly. If volume is advanced too far the course may appear broad and the accuracy will be affected.

6. ON-OFF volume control knob — Rotate full counterclockwise (to turn receiver off).

As An Automatic Direction Finder.

1. ON-OFF volume control knob — ON.
2. Function selector switch — ANT position.
3. Band selector switch — Desired frequency range.
4. Tuning crank — Desired station frequency.
5. Function selector switch — COMP position. Adjust for maximum deflection on tuning meter.
6. ON-OFF volume control knob — Readjust for comfortable level.
7. Radio compass indicator — For magnetic bearing set heading of aircraft under the top index with the VAR knob. Read bearing to the station under the head of the bearing indicator.
8. Loop switch — Check operation of ADF by operating loop switch to left or right. Bearing indicator should return to same bearing when the switch is released. If it doesn't the signal should not be used for ADF navigation.
9. ON-OFF volume control knob — Rotate full counterclockwise (to turn receiver off).

As a Manually Controlled Direction Finder.

1. ON-OFF volume control knob — ON.

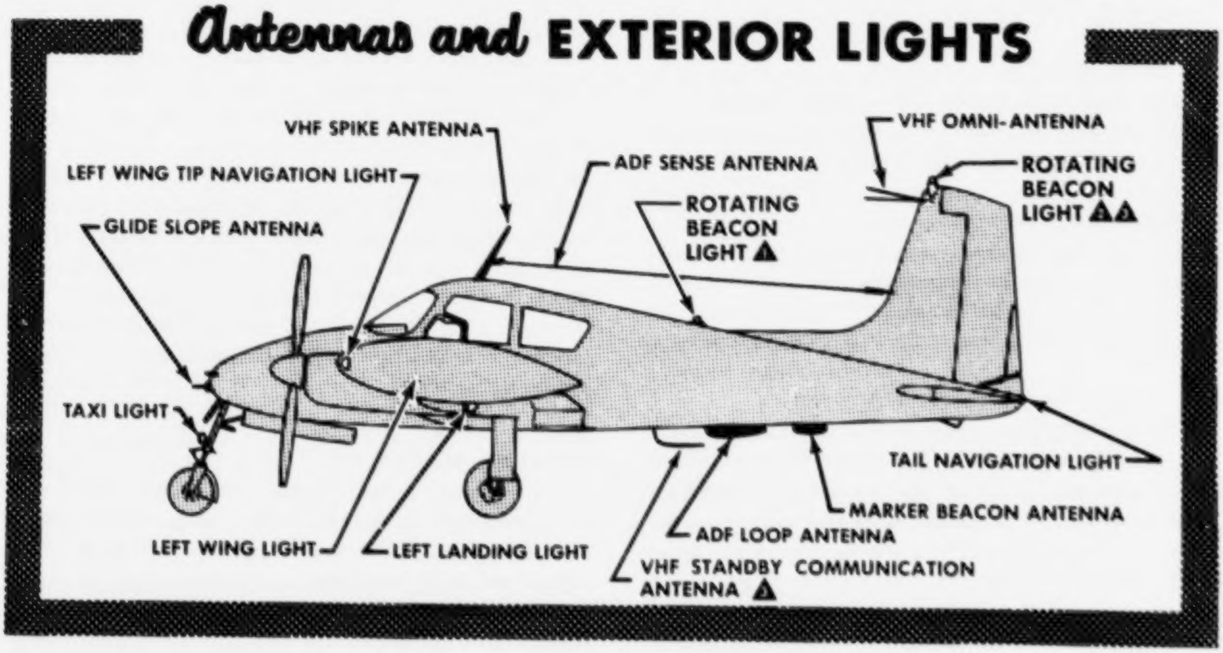


Figure 4-16

2. Function selector switch — ANT position.
3. Band selector switch — Desired frequency range.
4. Tuning crank — Desired station frequency.
5. Function selector switch — LOOP position.
6. BFO Switch — ON.
7. LOOP switch — Adjust, left or right, for null location.
8. ON-OFF volume control knob — Readjust for desired null width.
9. ON-OFF volume control knob — Rotate full counterclockwise (to turn receiver off).

ANTENNAS.

VHF Communications Antenna.

A broadband VHF spike antenna is located on the cabin top. The antenna is used for VHF communications only.

VHF Omni-Range Antenna.

The VHF omni-range antenna is a V-dipole type mounted on the vertical fin. The one antenna feeds both omni receivers.

Glide Slope Antenna.

The UHF glide slope antenna is a dipole type. The antenna is mounted on the fuselage nose cap and protrudes forward on the aircraft.

ADF Loop Antenna.

The ADF loop antenna is housed in a small protruding blister on the bottom of the tailcone.

ADF Sense Antenna.

A wire type sense antenna is mounted between the vertical fin and the VHF spike antenna. This antenna is used for ADF sense and LF reception.

Marker Beacon Antenna.

The marker beacon antenna is a cavity type resonator which has a plastic housing molded about the antenna elements. The antenna is mounted on the bottom of the tailcone directly behind the ADF loop housing.

VHF Standby Communications Antenna. ▲

The VHF standby communications antenna is a quarterwave, base-fed inverted L-antenna. The antenna is mounted on the bottom of the tailcone and is used for VHF standby communications only.

LIGHT EQUIPMENT.

All exterior and interior lights with the exception of the baggage compartment light on aircraft ▲ ▲ can be controlled from within the cabin. On aircraft ▲ ▲ the baggage compartment light is controlled by a switch mounted adjacent to the light in the baggage compartment. Exterior lighting equipment consists of the following: standard wing tip and tail navigation lights, rotating anti-collision light, two landing lights, a taxi light and a left wing light. Interior lighting equipment consists of the following: instrument and radio control panel lights, fuel selector valve lights, front and rear cabin dome lights, and a baggage compartment light. All lights are protected by push-to-reset circuit breakers and receive their power from the 28 volt dc bus.

NAVIGATION LIGHTS.

The navigation lights (figure 4-16) are provided as a means of indicating to other aircraft, the aircraft's position and heading under low visibility conditions such as night, weather, haze, etc. Wing tip lights are located in the nose portion of the wing tip fuel tanks; red in the left tank and green in the right tank. A clear light is installed at the tip of the fuselage stinger section. On aircraft ▲ a resistor is included in the navigation light circuit which dims the landing gear position indicator lights when the navigation lights are ON. This aids in subduing glare in the cabin during night operation. A blinker is also installed in the navigation light circuit to turn the lights on and off at regular intervals, when the navigation lights switch is ON. The navigation lights automatically change from blinker to steady operation when the rotating anti-collision light switch is turned ON. The wing tip navigation lights may be checked at night for operation by observing their location and noting whether the lights show through the small indicator hole on the inboard side of each light housing.

Navigation Lights Switch.

The navigation lights switch (18, figure 1-7), located on the left switch and control panel, is labeled NAV LT, and is ON in the up position and OFF in the down position. Operation of the switch controls the navigation lights circuit and on aircraft ▲ dims the landing gear position indicator lights when the navigation lights are on.

ROTATING BEACON LIGHT.

A rotating beacon light (figure 4-16) is mounted on top of the fuselage just forward of the dorsal fin on aircraft ▲ and on top of the vertical fin on aircraft ▲ ▲. The light is red, and rotates 360° at all times when the rotating beacon light switch is ON. The navigation lights change from blinker to steady operation when the rotating beacon light switch is turned ON.

CAUTION

The rotating beacon light should be turned off during flight through conditions at reduced visibility where the pilot could experience disorientation as a result of the rotating reflections of the light against the clouds.

Rotating Beacon Light Switch.

The rotating beacon light switch (19, figure 1-7) is located on the left switch and control panel. The switch is labeled ROT BCN, and is ON in the up position and OFF in the down position.

LANDING LIGHTS.

Landing lights (figure 4-16) are provided on the aircraft to provide illumination forward and downward during night takeoff and landing. One light is installed in the bottom of each wing just outboard of the main landing gear. The lights are retractable to reduce drag, and are controlled by one switch for each light.

CAUTION

Landing lights extension at cruising airspeeds will cause buffetting.

Landing Light Switches.

Right and left landing light switches (15, 16, figure 1-7) are mounted on the left switch and control panel at the extreme right end of the lower switch row. Each switch is a three-position toggle type. The switch positions are ON (up position), OFF (middle position) and RETRACT (down position). The right landing light switch is labeled R LDG LT, and the left landing light switch is labeled L LDG LT. When the switches are moved to ON, the landing lights extend and automatically illuminate when fully extended. When in the extended position, the landing lights may be turned off or on as desired by moving the switches to the middle position (OFF) and up position (ON). When the switches are moved to the down position (RETRACT), the landing lights will automatically go off, if on, and begin retracting. The lights will automatically stop when in the fully retracted position.

TAXI LIGHT.

A taxi light (figure 4-16) is mounted on the nose wheel shock strut to provide illumination of the area just forward of the aircraft during night ground operation and taxiing. The light is controlled by a taxi light switch.

Taxi Light Switch.

The taxi light switch (17, figure 1-7) is located on the lower switch row of the left switch and control panel. The switch is labeled TAXI LT, and is ON in the up position and OFF in the down position.

LEFT WING LIGHT.

A light (figure 4-16) is installed on the outboard side of the left engine nacelle and shines on the left wing leading edge. The light is especially useful on night flights during cold weather. The light may be turned on to illuminate the wing leading edge so that ice formations may be observed, and corrective action taken. The light is controlled by the left wing light switch.

Left Wing Light Switch.

The left wing light switch (9, figure 1-10; 9, figure 1-11) is located just to the right of the engine control pedestal on the right switch and control panel. The switch is labeled L WING LIGHT, and is ON in the up position, and OFF in the down position.

INSTRUMENT AND RADIO CONTROL PANEL LIGHTS.

All instruments mounted on the instrument panel, and on aircraft ▲1 ▲2 all radio control panels, with the exception of the LF navigation control panel, are illuminated by post type light. The LF navigation control panel on aircraft ▲1 ▲2 and all radio control panels on aircraft ▲3 are illuminated by edge-mounted lights. The instrument lighting circuits are controlled by two separate lighting rheostat knobs. Lighting for all flight instruments and the radio control panels is controlled by one rheostat knob. Lighting for all engine instruments and instruments associated with engine and other system operation is controlled by a second rheostat knob. Additional instrument panel lighting is provided by two overhead red instrument lights and one overhead white instrument light mounted in the forward end of the overhead console panel installed on the cabin ceiling. The two red lights are controlled by one rheostat knob, and the white light is controlled by a second rheostat knob.

Flight Instrument and Radio Control Panel Lights Rheostat Knob.

The flight instrument and radio control panel lights are controlled by a rheostat knob (29, figure 1-7) located on the left switch and control panel. The rheostat knob is labeled FLIGHT INST-RADIO, and is OFF in the extreme counterclockwise position. As the rheostat knob is rotated clockwise, the lights are ON, and their intensity is increased.

Engine Instrument Lights Rheostat Knob.

The lights which illuminate the engine instruments and instruments associated with the engine and other systems operation, are controlled by a rheostat knob (27, figure 1-7) located on the left switch and control panel. The rheostat knob is labeled ENGINE INST. and is OFF in the extreme counterclockwise position. As the rheostat knob is rotated clockwise, the lights are ON, and their intensity is increased.

Overhead Red Instrument Panel Lights Rheostat Knob.

The overhead red instrument panel lights are controlled by the left rheostat knob located halfway back on the overhead console panel (figure 4-19). The full counterclockwise position of the knob is OFF. As the rheostat knob is rotated clockwise, the lights are ON, and their intensity is increased.

Overhead White Instrument Panel Light Rheostat Knob.

The overhead white instrument panel light is controlled by the right rheostat knob located halfway back on the overhead console panel (figure 4-19). The full counterclockwise position of the knob is OFF. As the rheostat knob is rotated clockwise, the light is ON and its intensity is increased.

SWITCH AND CONTROL PANEL LIGHTS.

The left and right switch and control panel lights and the fuel selector valve light are controlled by a common rheostat knob (25, figure 1-7) located on the left switch and control panel. The rheostat knob is labeled SWITCH PNL-FUEL SEL, and is OFF in the extreme counterclockwise position. As the rheostat knob is rotated clockwise, the lights are ON, and their intensity is increased.

FUEL SELECTOR VALVE LIGHT.

The fuel selector valve handles and the selector plate are illuminated by a light (14, figure 1-4) mounted on the forward side of the front spar above them. The light is controlled by the rheostat knob which also controls the switch and control panel light.

Switch and Control Panel—Fuel Selector Valve Light Rheostat Knob.

The left and right switch and control panels are illuminated by post type lights. The lights are arranged to give maximum illumination with as few lights as possible to keep glare during night operation to a minimum. The lights are controlled by a single rheostat knob which also controls the fuel selector valve light.

MAGNETIC COMPASS LIGHT.

The magnetic compass contains an integrally mounted light for illumination during night operations. The light is controlled by a separate mounted rheostat knob. The magnetic compass light circuit is independent of the other lighting circuits, thus the light's intensity may be adjusted to pilot preference without interfering with other instrument lighting intensity.

Magnetic Compass Light Rheostat Knob.

The magnetic compass light rheostat knob (23, figure 1-7) is located on the left switch and control panel. The knob is labeled COMPASS, and is OFF in the extreme counterclockwise position. As the rheostat knob is rotated clockwise, the light is ON, and its intensity is increased.

DOME LIGHTS. ▲ ▲

Two dome lights are mounted in the cabin ceiling and provide illumination of the entire cabin area. The front dome light (2, figure 4-19) is mounted in the overhead console panel just forward of the oxygen outlets. The rear dome light (3, figure 1-19) is mounted directly over the passengers seat. Each light is controlled by a slide switch.

Dome Lights Switches. ▲ ▲

A slide switch controls each dome light. The front dome light switch (5, figure 4-19) is located just forward of the overhead instrument panel lights rheostat knobs. The rear dome light switch (2, figure 1-19) is mounted just behind the rear dome light.

DOME LIGHTS. ▲

Three dome lights are mounted in the cabin ceiling and provide illumination of the entire cabin area and baggage compartment. The front dome light (2, figure 4-19) is mounted in the overhead console panel just forward of the oxygen outlets. The middle dome light (3, figure 1-19) is mounted directly over the passenger seat. The rear dome light (8, figure 1-19) is mounted over the baggage compartment and provides lighting for the baggage compartment. Each light is controlled by a slide switch.

Dome Lights Switches. ▲

A slide switch controls each dome light. The front dome light switch (5, figure 4-19) is located just forward of the overhead instrument panel lights rheostat knobs. The middle and rear dome light switches (2, 9, figure 1-19) are mounted just behind the dome lights.

BAGGAGE COMPARTMENT LIGHT. ▲▲

A light (13, figure 1-19) is provided to illuminate the baggage compartment during night operations. The light is mounted just above the baggage compartment door.

OXYGEN SUPPLY SYSTEM Schematic

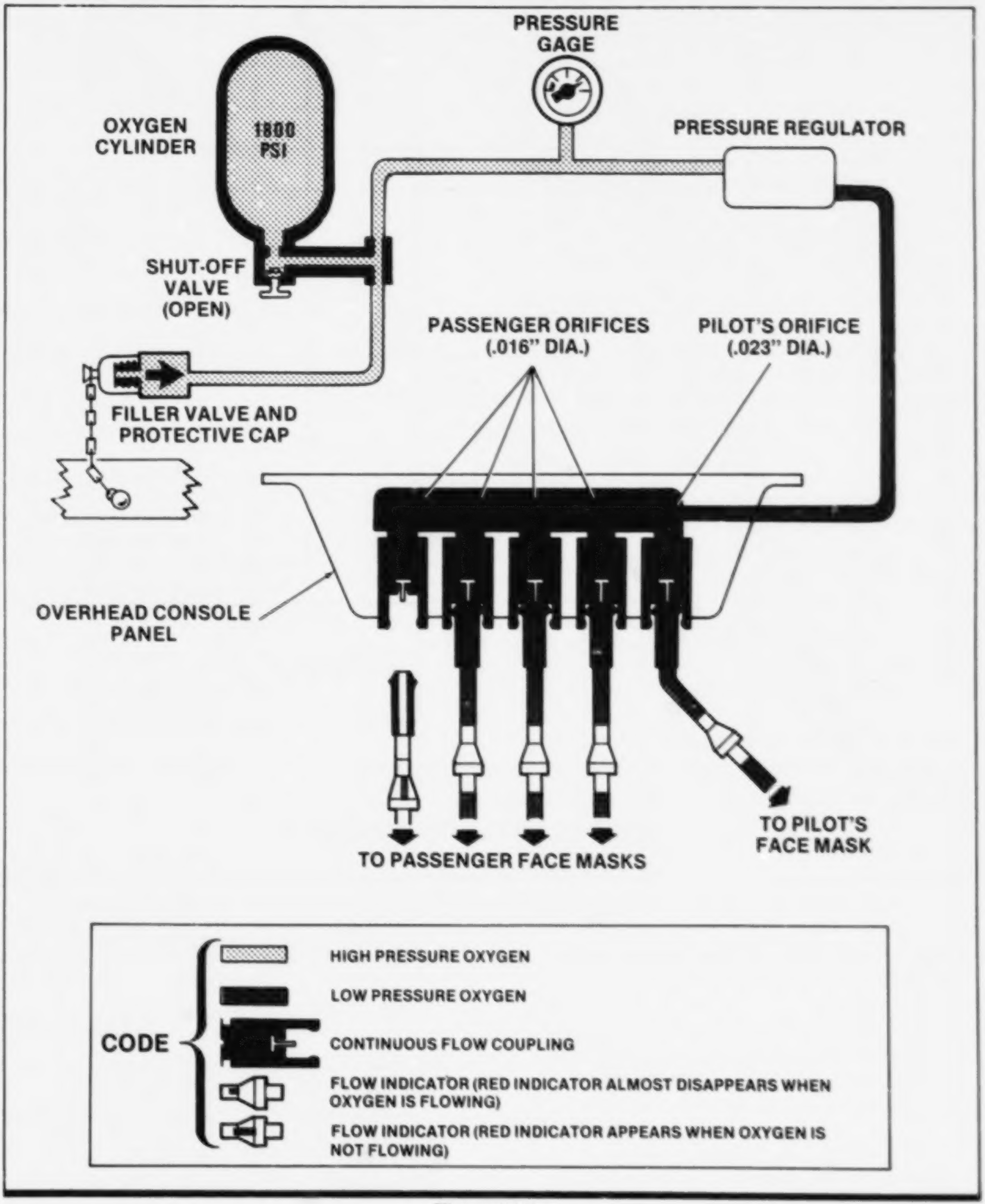

PRESSURE GAGE
OXYGEN CYLINDER
1800 PSI
PRESSURE REGULATOR
SHUT-OFF VALVE (OPEN)
PASSENGER ORIFICES (.016" DIA.)
PILOT'S ORIFICE (.023" DIA.)
FILLER VALVE AND PROTECTIVE CAP
OVERHEAD CONSOLE PANEL
TO PASSENGER FACE MASKS
TO PILOT'S FACE MASK
CODE
HIGH PRESSURE OXYGEN
LOW PRESSURE OXYGEN
CONTINUOUS FLOW COUPLING
FLOW INDICATOR (RED INDICATOR ALMOST DISAPPEARS WHEN OXYGEN IS FLOWING)
FLOW INDICATOR (RED INDICATOR APPEARS WHEN OXYGEN IS NOT FLOWING)

Figure 4-17

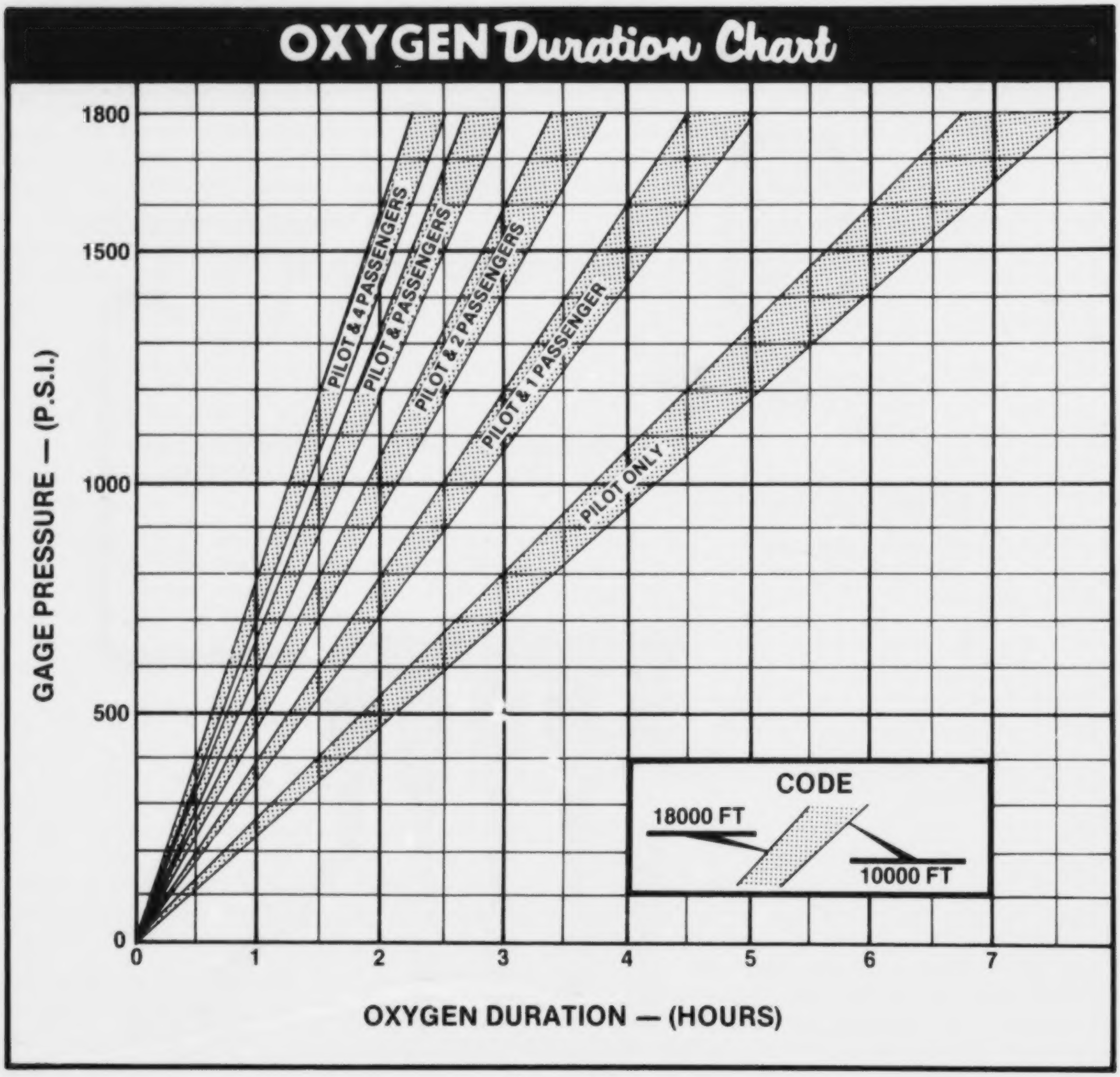
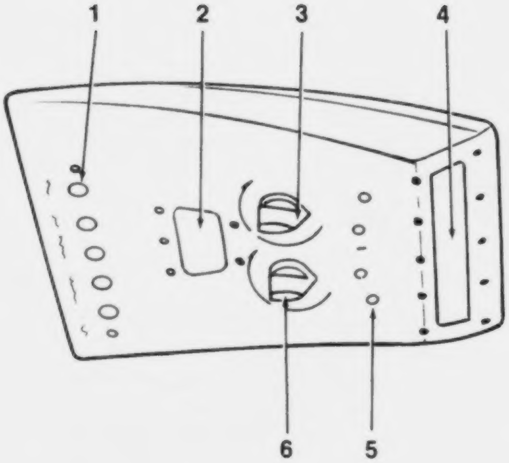

OXYGEN Duration Chart
GAGE PRESSURE — (P.S.I.)
1800
1500
1000
500
0
0
1
2
3
4
5
6
7
OXYGEN DURATION — (HOURS)
PILOT & 4 PASSENGERS
PILOT & 3 PASSENGERS
PILOT & 2 PASSENGERS
PILOT & 1 PASSENGER
PILOT ONLY
CODE
18000 FT
10000 FT

Figure 4-18

OVERHEAD CONSOLE PANEL



1. Oxygen System Outlet Couplings
2. Front Dome Light
3. Overhead White Instrument Panel Light Rheostat Knob
4. Overhead Red and White Instrument Panel Lights
5. Front Dome Light Switch
6. Overhead Red Instrument Panel Light Rheostat Knob

Figure 4-19

Note

Oxygen is automatically routed through the continuous flow couplings, hoses, and flow indicators to the face masks whenever the hoses are connected to the continuous flow couplings. To conserve oxygen, supply hose should be disconnected from the overhead console panel any time the face mask is removed.

FACE MASKS.

The face masks used with this oxygen supply system are of the disposable, partial-rebreathing type. They can be re-used if marked for identification by the frequent user, or can be thrown away after each use since they are reasonably inexpensive. Normal conversation, including use of microphone, can be carried on while wearing the masks. Each face mask receives oxygen through a rubber hose into a rebreather bag. On exhalation the first air exhaled (which is rich in oxygen because it never reaches the lungs) is exhaled into the bag, combining with the incoming oxygen. As soon as the bag is filled, the remainder of the exhaled breath (which is low in oxygen, because it has been in the lungs) is exhaled to the atmosphere through the upper sides of the bag. On inhalation, the user inhales the oxygen-enriched contents of the bag. When the bag is emptied, air is drawn through the upper sides of the bag to finish satisfying the inhalation volume of the user. When not in use, the face masks are stored in a plastic bag which is kept on the utility shelf.

OXYGEN FLOW INDICATORS.

An oxygen flow indicator is provided in each face mask hose. It provides a visual indication that oxygen is flowing to the mask in that a red indicator almost disappears when oxygen is flowing. The oxygen flow indicators operate in any position.

OXYGEN PRESSURE GAGE.

An oxygen pressure gage (7, 10, figure 1-19) is mounted on the aft portion of the utility shelf, and is readily visible to the pilot and passengers. The gage indicates oxygen cylinder pressure, and should indicate 1800 psi when the system is fully charged. When the pressure indication is reduced to 300 psi, the oxygen system should be recharged. The gage is marked with two green arcs. One arc runs from 0 to 300 psi and the other from 1550 to 1850 psi.

OPERATION OF THE OXYGEN SUPPLY SYSTEM.

The oxygen system operation is automatic in that no manual regulation is required to compensate for change in altitude, or to shut off the oxygen flow when the system is not in use. To operate the system, proceed as follows:

Prior to Flight.

1. Oxygen cylinder shut-off valve handle—Check OPEN (valve handle rotated full counterclockwise).
2. Oxygen pressure gage—Check for sufficient pressure for anticipated requirements of the flight (see Oxygen Duration Chart, figure 4-18).

During Flight.

1. Mask and hose—Select from pastic bag on utility shelf. If mask and hose are not connected, attach by inserting short plastic tube on mask

securely into end of rubber hose.

2. Mask—Attach in place over face.

WARNING

It is recommended that no smoking be permitted when using the oxygen system. Although oxygen in itself is not combustible, it does support combustion and under certain conditions is extremely dangerous to the occupant who smokes while using the oxygen system.

3. Select oxygen continuous flow coupling in overhead console panel and insert fitting of masks hose into coupling.

Note

The extreme left coupling in the overhead console panel is labeled PILOT and is intended for this use. It contains a .023 diameter orifice which meters approximately double the volume of the oxygen metered to the four remaining passenger couplings. The passengers couplings contain .016 diameter orifices. However, the pilot's coupling may be used for any of the passengers who desire additional oxygen.

4. Oxygen flow indicator—Check that red indicator almost disappears when hose is inserted into coupling to insure that oxygen is flowing.

Note

As an aircraft ascends to high altitudes, where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 100°F decrease in temperature in the cylinder the gage pressure can be expected to drop 20 per cent. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the aircraft descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the aircraft is in level flight, or while it is descending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

MISCELLANEOUS EQUIPMENT.

PASSENGER SEAT.

PASSENGER SEAT

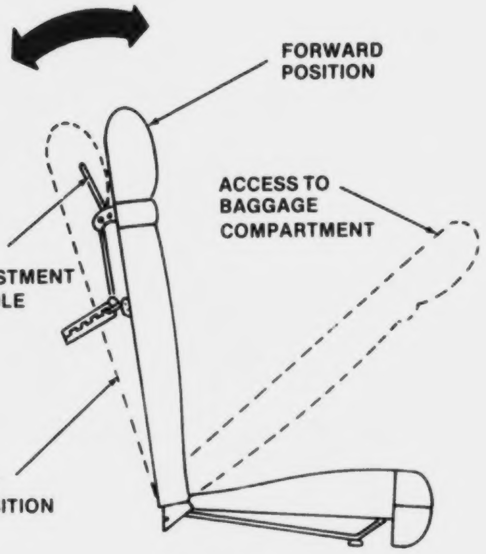


Figure 4-20

The passenger seat (7, figure 1-2 and figure 4-20) located just behind the pilot and copilot seats, is designed to accommodate three people. The seat back is hinged at the two lower attachment points. By actuation of the seat adjustment handle (figure 4-20), the seat back can be moved forward or aft through five adjustments to provide the most comfortable reclining angle as desired by the passengers. The seat adjustment handle mechanism also disengages completely from position adjustment brackets to allow the seat back to be pulled forward to its extreme limit to permit access to the baggage compartment from within the cabin.

CABIN WINDOWS.

All of the cabin side windows, with the exception of the pilot's storm window, (6, figure 1-17) are of the fixed type. The cabin side windows and pilot's storm windows are of tinted glass to reduce glare and solar heat transfer. The pilot's storm window opens outward and downward, and utilizes a stop which limits its travel to approximately 90°.

CAUTION

Do not open the pilot's storm window at speeds in excess of 130 mph IAS, due to the structural limitations of the window.

The pilot's storm window is unlocked by pressing the push-button lock and rotating the latch handle (5 figure 1-17) counterclockwise. Clockwise rotation of the latch handle locks the window when closed. Opening the window allows the cabin door to be closed more easily by providing a means of releasing cabin internal pressure.

CIGARETTE LIGHTERS.

Two conventional cigarette lighters are provided in the aircraft. The front cigarette lighter (15, figure 1-3) is mounted on the lower left corner of the instrument panel. On aircraft ▲1 ▲2 a cigarette lighter (4, figure 1-18) is mounted on the lower side of the right rear window sill. On aircraft ▲3 a cigarette lighter (17, figure 1-17) is mounted on the lower side of the left center window sill.

ASH RECEIVERS.

Four ash receivers are provided in the aircraft. One (14, figure 1-17) is located beneath the circuit breaker panel in the left cabin wall for the pilot's use. One (7, figure 1-18) is located in the cabin door for use by the copilot. The remaining two (19, figure 1-17; 6, figure 1-18) are located in the cabin walls at each end of the passenger seat.

MAP COMPARTMENT.

A map compartment (6, figure 1-10; 6, figure 1-11) is located within the right switch and control panel. The map compartment is accessible by pulling the map compartment door out and downward.

COAT HANGER HOOKS.

Two coat hanger hooks (4, figure 1-19) are provided in the cabin ceiling above the back of the passenger seat. Coats can be hung between the back of the seat and the utility shelf.

UTILITY SHELF.

A utility shelf (4, figure 1-2) is located just above the baggage compartment, providing storage space for the first aid kit and oxygen face masks and hoses.

BAGGAGE COMPARTMENT.

A baggage compartment (2, figure 1-2) is located just aft of the passenger seat. A baggage compartment door (27, figure 1-2; 15, figure 1-19) is provided just aft of the wing on the right side of the fuselage for access to the baggage compartment from the outside of the aircraft. A recessed push-button on the aft side of the door opens the baggage door. A lock is provided just forward of this push-button and is operated by the same key that operates the cabin door lock. A limit chain is used as a door stop to prevent the door from being opened back against the fuselage. The door is closed by pushing the door shut until the latch catches. Access to the baggage compartment is gained from inside the cabin by actuating the seat adjustment handle and pulling the back of the passenger seat forward and down.

CARGO TIE-DOWN RINGS.

Provisions are made for the installation of eight cargo tie-down rings in the cabin and baggage compartment floors. The rings are not installed, but are provided separately. The tie-down ring locations are two directly beind the front seats, two in the rear spar, and four in the baggage compartment area.

TOW BAR.

A tow bar (6, figure 1-2) is stored in the baggage compartment for use during ground handling of the aircraft. The tow bar attaches to the nose gear and provides positive control when steering the aircraft by hand.

CAUTION

Always pull or push horizontally on the tow bar when moving the aircraft to keep the weight on the nose wheel for positive steering action. Do not lift. Do not tow the aircraft with a vehicle.

SCREWDRIVER.

A special, hollow handled screwdriver is provided to facilitate operation of the fuel strainer, main fuel tank drain valves and on aircraft ▲ the auxiliary fuel tank drains valves. Access to the fuel strainer drain valve is gained through an access door in the bottom of the engine cowl. The main fuel tank drain valves may be reached by inserting the special hollow handled screwdriver through the hole in the bottom of each main fuel tank. On aircraft ▲ the auxiliary fuel tank drain valve may be reached from the bottom of each wing just out-board of each engine nacelle. The drain valves may be opened for small quantity fuel drainage by engaging the screwdriver with the bottom of the drain valve and pushing up while rotating the screwdriver counterclockwise. (Fuel will flow through the hollow handle of the screwdriver.) The valves are closed by rotating the screwdriver clockwise and releasing pressure sharply, thus permitting the spring load in the valve to shut off the flow of fuel.

ASSIST STEP.

A retractable assist step provides easy access to the wing walk when boarding or leaving the aircraft. The step is mechanically connected to the landing gear linkage, and extends and retracts with the gear.

SUN VISORS.

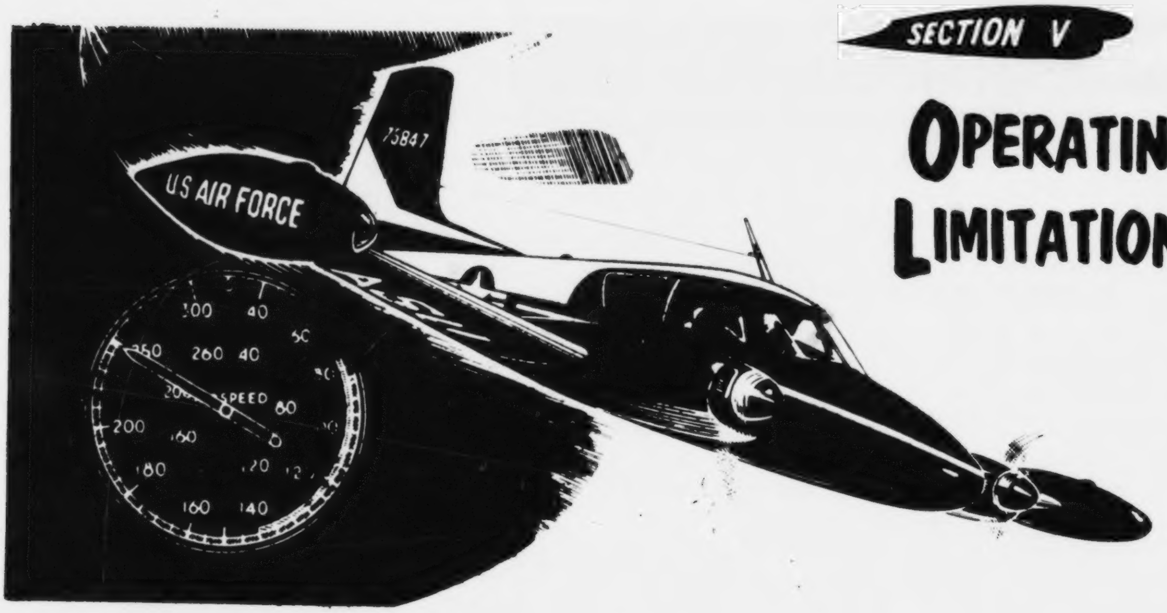
Two sun visors (4, figure 1-17; 1, figure 1-18) are provided just back of the windshield on the cabin ceiling. The sun visors are of transparent tinted plexiglas, and when in position do not restrict the view of front seat personnel. The sun visors are adjustable up and down, and are full swivel so that they may be moved to either the front or the side window.

CHECKLISTS.

A pilot's checklist (11, figure 1-17) containing information on engine and flight operation procedures is located in a small pocket in the left cabin wall upholstery adjacent to the pilot's seat. A decaled list of operating limitations is provided on the main circuit breaker panel door on the left cabin wall.

SECTION V

OPERATING LIMITATIONS



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MINIMUM CREW REQUIREMENTS.

While there is a provision for both a pilot and a copilot, the aircraft may be flown easily and safely by one pilot.

INSTRUMENT MARKINGS.

Refer to figure 5-1 or figure 5-2 for details of all instrument markings. Special attention should be given to the instrument marking diagrams since they represent limitations which are not necessarily repeated in the text. In some cases, further explanation of the instrument markings will be found in the text under appropriate paragraph heading.

ENGINE LIMITATIONS.

For continuous engine operation, maximum manifold pressure shall not exceed three inches Hg above rpm (example 24 inches Hg for 2100 rpm). All normal engine limitations are shown in figure 5-1 and 5-2. The maximum allowable engine speed is 2600 rpm on aircraft ▲ ▲ and 2625 rpm on aircraft ▲. The recommended maximum cruise power is 180 BHP or 2450 RPM and 24 inches Hg. An engine overspeed of 3150 rpm to 3400 rpm requires that the engine be inspected. There are no additional limitations when using alternate grade fuels.

CAUTION

Whenever engine speed exceeds the operating limit, the aircraft should be landed at the nearest service facility. The reason for the overspeed (if known), the maximum rpm and duration will be entered in Form 781.

PROPELLER LIMITATIONS.

The maximum allowable propeller speed is 2600 rpm on aircraft ▲ ▲ and 2625 rpm on aircraft ▲. A propeller overspeed in excess of 3150 rpm necessitates a propeller teardown for inspection, and the reason for the overspeed (if known), the maximum rpm, and duration will be entered in Form 781.

AIRSPEED LIMITATIONS. ▲ ▲ ▲

The airspeed limitations listed below are based on the maximum gross weight of 4830 pounds. All maximum airspeeds are based on structural limitations.

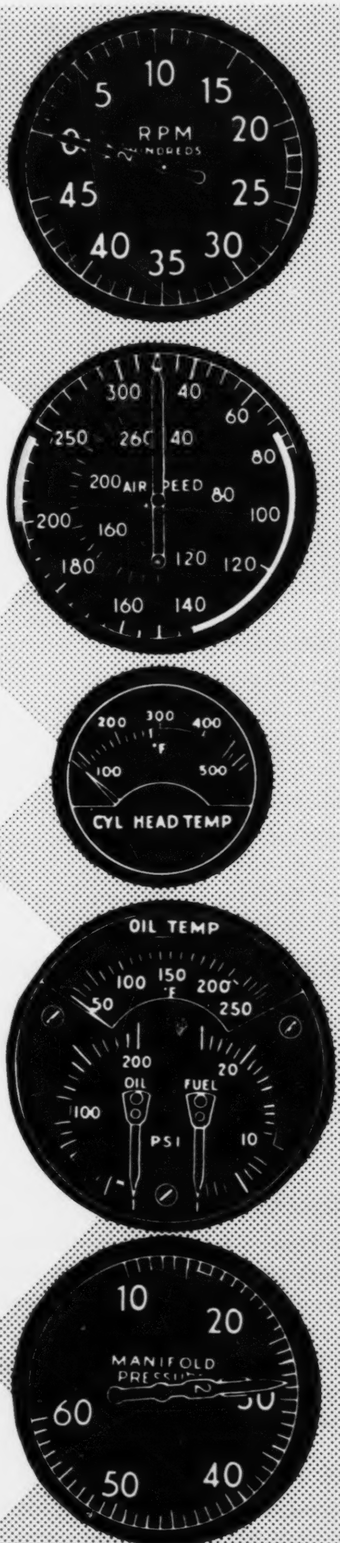
Maximum allowable airspeed (glide or dive in smooth air)	248 mph IAS
Caution range	200-248 mph IAS

CAUTION

Cruising or maneuvering flight in turbulent air within this speed range should be done

INSTRUMENT Markings △1 △2

(BASED ON FUEL GRADE 91/96)



TACHOMETER

▬ 2100-2450 RPM, NORMAL
▬ 2600 RPM, MAXIMUM,

AIRSPEED INDICATOR

▬ 248 MPH, MAXIMUM
▭ 200-248 MPH, CAUTION RANGE
▬ 84-200 MPH, NORMAL
▭ 74-140 MPH, WING FLAPS AND LANDING GEAR OPERATING RANGE

CYLINDER HEAD TEMPERATURE

▬ 275-470°, NORMAL
▬ 470°, MAXIMUM

OIL TEMPERATURE

▬ 75-225°, NORMAL
▬ 225°, MAXIMUM

OIL PRESSURE

▬ 10 PSI, IDLING
▬ 30-60 PSI, NORMAL
▬ 100 PSI, MAXIMUM

FUEL PRESSURE

▬ 9 PSI, MINIMUM
▬ 9-15 PSI, NORMAL
▬ 15 PSI, MAXIMUM

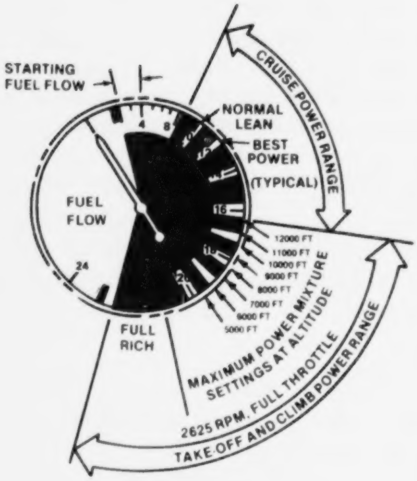
MANIFOLD PRESSURE

▬ 15-24 INCHES MERCURY, NORMAL

Figure 5-1

INSTRUMENT Markings ⚠

(BASED ON FUEL GRADE 100/130)



FUEL FLOW GAGE

0 GAL/HR FUEL FLOW ■
1.7-22.7 GAL/HR FUEL FLOW ■
23 GAL/HR FUEL FLOW MAXIMUM ■

OIL PRESSURE

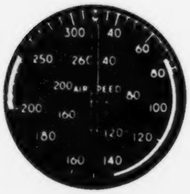
10 PSI, IDLING ■
30-60 PSI, NORMAL ■
100 PSI, MAXIMUM ■

OIL TEMPERATURE

80-225° F, NORMAL ■
225° F, MAXIMUM ■

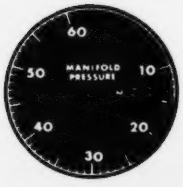
CYLINDER HEAD TEMPERATURE

300-460°F, NORMAL ■
460°F, MAXIMUM ■



AIRSPEED INDICATOR

252 MPH, MAXIMUM ■
210-252 MPH, CAUTION RANGE □
85-210 MPH, NORMAL ■
75-140 MPH, WING FLAPS AND LANDING GEAR OPERATING RANGE □



MANIFOLD PRESSURE

15-24 INCHES MERCURY NORMAI ■

TACHOMETER

2100-2450 RPM, NORMAL ■
2625 RPM, MAXIMUM ■

Figure 5-2

with caution to avoid excessive structural loads.

Maximum Speed	
Flaps extended 0-15°	160 mph IAS
Flaps extended 15-45°	140 mph IAS
Maximum speed, gear extended	140 mph IAS
*Maneuvering speed	164 mph IAS
Maximum speed, landing light extended	160 mph IAS
Recommended speed, landing light extended	140 mph IAS
Maximum speed, pilot's window open	130 mph IAS

*The maximum speed at which you can use abrupt full control travel without exceeding the design load factor.

AIRSPEED LIMITATIONS. ▲3

The airspeed limitations listed below are based on the maximum gross weight of 4990 pounds. All maximum airspeeds are based on structural limitations.

Maximum allowable airspeed (glide or dive in smooth air)	252 mph IAS
Caution range	210-252 mph IAS

CAUTION

Cruising or maneuvering flight in turbulent air within this speed range should be done with caution to avoid excessive structural loads.

Maximum Speed.	
Flaps extended 0-15°	160 mph IAS
Flaps extended 15-45°	140 mph IAS
Maximum speed, gear extended	140 mph IAS
*Maneuvering speed	167 mph IAS
Maximum speed, landing light extended	160 mph IAS
Recommended speed, landing light extended	140 mph IAS
Maximum speed, pilot's window open	130 mph IAS

*The maximum speed at which you can use abrupt full control travel without exceeding the design load factor.

PROHIBITED MANEUVERS.

Spins or acrobatic maneuvers are strictly prohibited.

ACCELERATION LIMITATIONS.

The maximum maneuvering load factors for the maximum gross weight of 4830 pounds on aircraft ▲1 ▲2 ▲4 and 4990 pounds on aircraft ▲3 are as follows:

*Flight load factor, flaps up	+3.8g-1.52g
*Flight load factors, flaps down	+2.0g

*The design load factors are 150% of the above, and in all cases the structure exceeds design loads.

CENTER OF GRAVITY LIMITATIONS.

The aircraft recommended weight and center of gravity limits will not normally be exceeded by loading arrangements employed in passenger transporting operations. Refer to T.O. 1U-3A-5 for center of gravity limits.

Note

Baggage compartment load is restricted to 200 pounds maximum.

WEIGHT LIMITATIONS. ▲1 ▲2 ▲4

The maximum takeoff gross weight for this aircraft is 4830 pounds. (Above this weight, structural failure may result if a load factor in excess of 3.8g is obtained). The maximum gross weight for landing is 4600 pounds. (Above this weight, landing gear failure may result if a load factor in excess of 3.8g is obtained.)

When loaded to a maximum takeoff gross weight, it takes approximately one and one-half to two hours to use the 38.3 gallons (230 pounds) of fuel which is required to lighten the aircraft to the maximum landing gross weight of 4600 pounds. If a flight of shorter duration than one and one-half to two hours is planned, the aircraft should be loaded to less than the maximum takeoff gross weight to permit landing at 4600 pounds or less.

The approximate basic weight of the aircraft is 3145 pounds on aircraft ▲1 ▲2 and 3200 pounds on aircraft ▲4.

CAUTION

Check your load carefully. Two pilots, three passengers, full fuel (both main and auxiliary tanks full) and baggage can overload the aircraft, requiring a reduction in fuel, baggage or passenger load. Based on mission requirements, the maximum gross weight may be exceeded only as deemed necessary by the Unit Commander.

WEIGHT LIMITATIONS. ▲3

The maximum takeoff gross weight for this aircraft is 4990 pounds. (Above this weight structural failure may result if a load factor in excess of 3.8g is obtained.) The maximum gross weight for landing is 4750 pounds. (Above this weight, landing gear failure may result if a load factor in excess of 3.8g is obtained.)

When loaded to a maximum takeoff gross weight, it takes approximately one and one-half to two hours to use the 40.0 gallons (240 pounds) of fuel required to lighten the aircraft to the maximum landing gross weight of 4750 pounds. If a flight of shorter duration than one and one-half to two hours is planned, the aircraft should be loaded to less than the maximum takeoff gross weight to permit landing at 4750 pounds or less.

The approximate basic weight of the aircraft is 3330 pounds

CAUTION

Check your loading carefully. Two pilots, three passengers, full fuel (both main and auxiliary tanks full) and baggage can overload the aircraft, requiring a reduction in fuel, baggage or passenger load. Based on mission requirements the maximum gross weight may be exceeded, only as deemed necessary by the Unit Commander.

PROHIBITED OPERATION.

Operation of aircraft with less than five (5) gallons of fuel in each main tank is prohibited.

SECTION VI

FLIGHT CHARACTERISTICS

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GENERAL FLIGHT CHARACTERISTICS.

The stability and control characteristics of the aircraft are very satisfactory. Control forces are light and adequate control is available throughout the operating speed range. When properly trimmed, the aircraft will remain in straight and level flight with little attention from the pilot.

STALLS.

NORMAL STALLS.

The stall characteristics of the aircraft are conventional in all configurations. Both visual and aural warnings are provided by the stall warning indicator light and warning horn between five and 10 mph above the stall in all configurations. The stall is also preceded by mild aerodynamic buffet which increases in severity as the stall is approached. The full power-on stall occurs at a very steep angle either with or without flaps, and it is difficult to inadvertently stall the aircraft during normal maneuvering. The stall characteristics in all configurations are characterized by a clean drop of the nose accompanied by increased buffet during the stall. The rudder should be used to prevent yaw during the approach to the stall since a rolling tendency will result if the aircraft is allowed to yaw. Recovery is effected very quickly with little loss of altitude if the nose is not lowered excessively and full available power is applied to both engines. Landing gear and flap position have little effect on the stall characteristics except that the stalling speed will be lowered in proportion to the degree of flap extension. On aircraft ▲ ▲ under normal conditions at 4830 pounds gross weight, the use of 45° flaps will lower the power-off stalling speed from approximately 80 mph IAS to 65 mph IAS and on aircraft ▲ under normal conditions at 4990 pounds gross weight, the use of 45° flaps will lower the power-off stalling speed from approximately 82 mph IAS to 73 mph IAS, permitting a slow steep approach for short field landings over an obstacle. Refer to figure 6-1 for stalling speeds.

ACCELERATED STALLS.

Stalls in accelerated flight are preceded by both the stall warning indicator light and warning horn indications, and by aerodynamic buffet.

PRACTICE STALLS.

Practice stalls should include power-on and power-off stalls in straight and turning flight with recovery initiated both before and after the downward pitch of the nose. Retard the throttles smoothly for power-off stalls, and use power settings of approximately 2450 rpm and 13 inches Hg for power-on stalls. In power-off stalls, the aircraft may be stalled in approximately the landing attitude. Recoveries should include dropping the nose slightly to regain flying speed without the addition of power and application of full available power while maintaining approximately the stall atti-

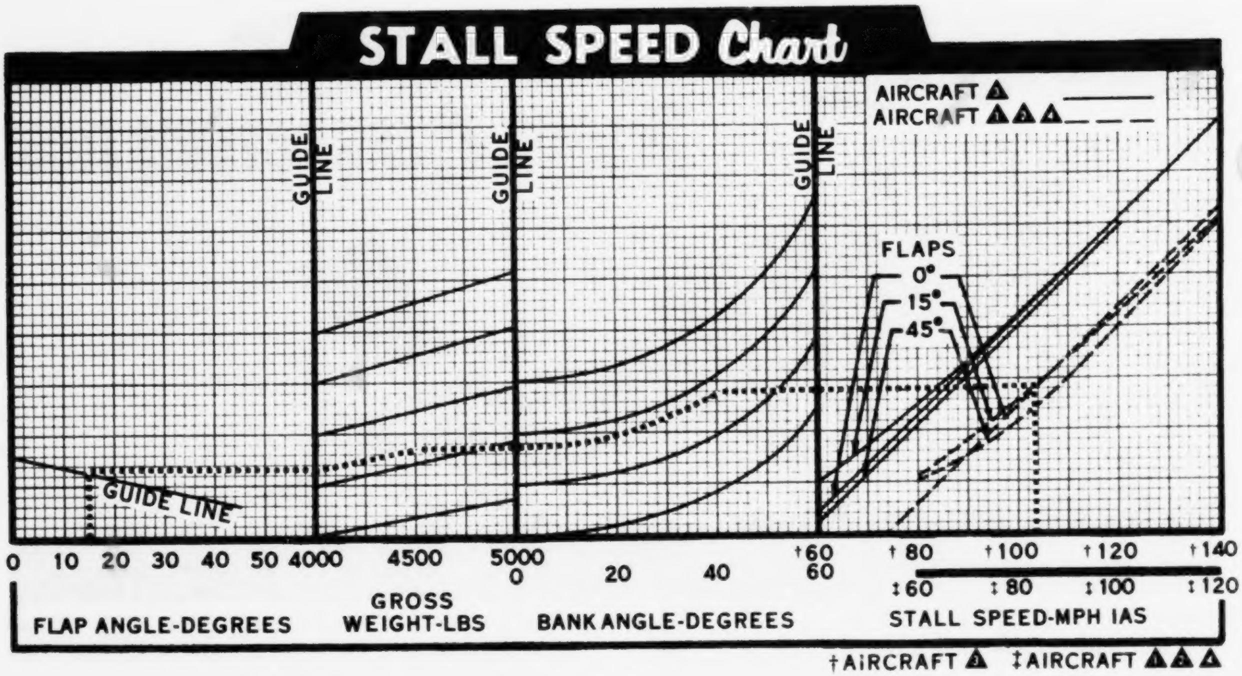


Figure 6-1

tude. In either case, the nose should not be lowered appreciably, and the return to level flight should be initiated immediately to prevent excessive loss of altitude. The recovery from power-on stalls can be accomplished with a very slight lowering of the nose, and the aircraft should fly out of the stall with little if any altitude loss. These stalls occur at very steep attitude and are more subject to yaw effects than power-off stalls. Practice stalls should also include single-engine full power stalls. A gradual loss of directional and lateral control is experienced as the stall is approached and the power on the operating engine should be reduced to maintain unyawed flight. If no yaw is present at the stall, no adverse characteristics will be encountered, and a normal recovery can be effected.

SPINS.

Intentional spins are not permitted in this aircraft, and due to the excellent stall warning system provided, it is not probable that an inadvertent spin will be encountered. Should a spin occur, however, the following recovery procedure should be employed:

- Cut power on both engines.
- Apply full rudder opposing the direction of rotation.
- Approximately ½ turn after applying rudder, push control wheel forward briskly.
- To expedite recovery, add power to the engine toward the inside of the direction of turn.
- Pull out of dive with smooth steady control pressure.

The altitude lost in a spin is not known.

FLIGHT CONTROLS.

Elevator control forces are relatively light in cruising flight at all aircraft loadings. Reducing power and extending the flaps and landing gear increases the elevator control forces appreciably thereby enhancing the control feel at low airspeeds. Aileron control forces are light and aileron control is much more effective than is at first apparent from control feel. This is more pronounced at slow speeds with full wing tip (main) tanks where the time response to aileron deflection is increased slightly. Rudder forces are comparatively light and only slight rudder pressure is required when rolling into and out of turns. All trim tabs are effective throughout the speed range of the aircraft with the rudder and elevator trim becoming very effective at cruising airspeeds.

LEVEL FLIGHT CHARACTERISTICS UNDER VARIOUS SPEED CONDITIONS.

The aircraft is conventional in all respects throughout the level flight speed range. Slow flying is easily accomplished either with wing flaps up or down or landing gear up or down. No special technique is required other than to realize that the aircraft is very clean and, therefore, sensitive to power adjustment.

MANEUVERING FLIGHT.

No acrobatic maneuvers are approved in this aircraft. The aircraft is, however, conventional in all respects throughout the maneuvering range encountered in normal flight.

WARNING

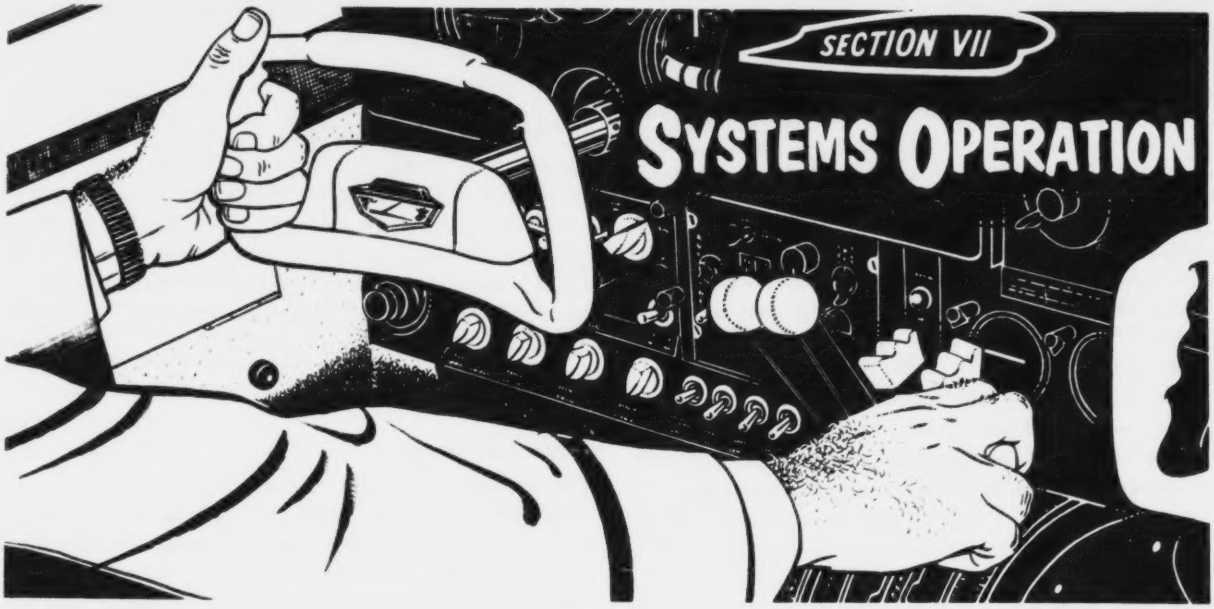
Steep bank angles and/or uncoordinated flight maneuvers, while using auxiliary fuel system with less than five (5) gallons of fuel remaining in the auxiliary fuel tanks, may cause engine surging or temporary power loss due to fuel starvation. Surging or complete loss of engine power on the inside of a steep bank turn will cause a rapid increase in bank angle and a nose down attitude, which results in an altitude loss before recovery can be completed.

DIVING.

Dives should be limited to the maximum diving airspeed (248 mph IAS on aircraft ▲1 ▲2 ▲4, 252 mph IAS on aircraft ▲3) marked on the airspeed indicator. Although trim changes and flight characteristics are conventional, caution should be exercised because the aircraft picks up speed rapidly, and if rough air is encountered unexpectedly, it is difficult to slow the aircraft down to a safe speed. Pull outs should be very gentle to avoid excessive stresses in the aircraft as well as discomfort to the passengers.

ASYMMETRICAL LOADS.

Flights with one main fuel tank full and one empty should be avoided. However, if such a condition should develop during flight, considerable aileron will be necessary during the approach and landing. In this condition, the aircraft can be controlled, but lateral control is marginal in rough air due to the amount of aileron deflection required below 100 mph IAS.



SECTION VII

SYSTEMS OPERATION

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INTRODUCTION.

This section presents additional material on the operation of various aircraft systems to supplement or amplify information given in Section II.

ENGINES. ▲ ▲

To achieve the level flight performance shown in the range charts in Appendix I, each engine should be leaned individually until a slight engine roughness is detected and then enriched two to four notches, this will give approximate best power. To reduce the chances of momentary engine stoppage, while searching for the mixture that produced rough operation, the numbered index mark on the mixture lever quadrant corresponding to the typical lean mixture setting should be identified. During subsequent leaning procedures the mixture lever may be quickly moved to this mark and then adjusted carefully as instructed above. This mark may be a very representative lean mixture setting for a variety of power settings and altitudes in normal outside air temperatures. If maximum range is desired, the mixture may be leaned to the minimum setting at which smooth engine operation can be maintained. In hot weather, where mixture distribution to each cylinder is quite uniform, this type of leaning may result in a five to 15 mph speed loss, depending upon altitude, power setting, and air temperature.

Since extremely lean mixtures produce low cylinder head temperatures, extended operation with these mixtures in cool weather may cause spark plug fouling and marginal cylinder wall lubrication. If these problems are encountered, the range may have to be compromised by operating at richer mixtures and higher engine speeds. Do not lean mixture with power setting above 24 inches of manifold pressure and 2450 rpm. The pressure carburetors on these engines are considered to be non-icing type. In addition, the internal location of the carburetor air intake should preclude the possibility of impact ice covering the intake air filter. However, there is a possibility of induction ice forming downstream from the carburetor in the intake manifold. To counteract this and to improve fuel vaporization in extremely cold weather, carburetor heat shrouds are installed on each engine. If rough engine operation in cold weather indicates a need, the carburetor air knobs should be fully opened (out position). This action closes butterfly type valves in the air intake ducts which results in a momentary suction in these ducts. The suction pulls open spring-loaded valves located between the carburetors and the closed butterfly valves, allowing heated (approximately 43° C or 110° F) air to flow from the shrouds around the exhaust stacks into the carburetors. It can be seen that partial carburetor air application is to be avoided, since this would result in low power at full throttle, erratic airflow through the carburetor, and possible rough engine operation due to poor mixture distribution.

All movements of the throttles should be made slowly and smoothly to preclude any possibility of propeller surging.

ENGINES. ▲

This aircraft is equipped with continuous flow fuel injection.

This design provides a more uniform fuel distribution to the cylinders and results in greater engine efficiency. The system uses the continuous flow principle which means that fuel is continuously sprayed into the intake ports of each cylinder and drawn into the cylinder through a conventional intake valve. The quantity of fuel delivered to the cylinders is metered by two separate valves within the system, one connected to the mixture lever and the other to the throttle. The valve connected to the throttle meters the fuel to obtain the proper fuel-air ratio at sea level for all throttle lever positions. However, since there in only a mechanical linkage between the throttle lever and the fuel metering valve, the mixture lever must be used to lean the mixture at all altitudes above sea level.

For example, at maximum power (2625 rpm and full throttle) at sea level, each engine develops 260 horsepower and requires approximately 22 gallons of fuel per hour (FULL RICH). However, if the aircraft is being operated at 10,000 feet with maximum power (2625 rpm and full throttle) the resulting manifold pressure will be approximately 20.0 in Hg and the engines will develop approximately 182 horsepower. Since the metering valve connected to the throttle senses only the physical position of the throttle lever, it will remain fully open and the engines will receive 22 gallons per hour while requiring only 17.5 gallons per hour for maximum power if the mixture lever is FULL RICH. Although the fuel consumed at 10,000 feet with the mixture set at FULL RICH is 30% in excess of the required amount, the fuel is distributed uniformly to all cylinders and the engines will not "run rough" but will suffer a substantial loss in power. At altitudes above 10,000 feet with the mixture levers in FULL RICH, the mixture becomes increasingly richer with altitude until the engines will no longer operate due to excessively rich mixtures.

Because of uniform fuel distribution the familiar "threshold of roughness" that occurs when carburetors are used is not present and cannot be used to establish the correct mixture settings. Establishing the correct settings is strictly a mechanical process accomplished by adjusting the mixture levers to obtain the correct fuel flow values for any operating conditions. The correct mixture settings during climbing flight are shown in figures A2-4-1 and A2-4-3 and for cruising flight in figures A2-5-2.

SPARK PLUG FOULING.

Spark plug fouling is a principle cause of ignition trouble. Fouling might be defined as an accumulation of deposits which cause misfiring or firing across the spark plug electrodes. The most common types of fouling are lead fouling and carbon fouling, with lead fouling the main trouble-maker. Prevention appears to be the most profitable line of attack on the problem.

GROUND RUNNING.

Type and Cause.

Either lead or carbon fouling. Lead fouling may be residual from a previous flight. Carbon fouling is usually due to prolonged ground running at idle, particularly when the idle mixture is richer than best power; excess carbon from the rich mixture plus engine oil in combustion tend to build up as fouling deposits. The symptoms of such fouling usually include excessive mag drop during ignition check.

Prevention.

Wherever possible avoid prolonged, or unnecessary ground running. The idle mixture should be adjusted to best power mixture at the idle speed commonly used for ground running, rather than at the minimum idle speed, since there is a tendency for the mixture to enrich with any increase in rpm and excessively rich idling mixtures are the most common cause of carbon fouling.

Note

> After each 10 minutes of ground running, the engine should be runup to maximum for one minute.

IN FLIGHT.

Type and Cause.

Cruise conditions usually generate lead fouling rather than carbon fouling. Conditions favorable to lead fouling include long continued application of a given set of engine conditions typical of cruise flight, particularly those involving very lean mixtures, at or leaner than best economy. Associated contributing factors include abnormally cool CHT and low BMEP. Common symptoms include backfiring or after firing.

Prevention.

A periodic change in engine conditons will usually forestall lead fouling. Here again prevention is preferable to cure. Hourly intervals are frequently used, and may accomplish results either by a change of three to five inches in manifold pressure, or a change of 100-130 rpm. A reduction in power level followed by an increase appears to be the preferable approach to prevention. One or more of these procedures should prove effective, and the procedure which least affects the flight condition, and is least noticeable to the passengers is naturally preferable.

Note

The aircraft ▲ ▲ , the boost pumps must be on if the primer is to be used in the procedure for prevention of lead fouling.

FUEL SYSTEM.

Note

Operation of aircraft with less than five (5) gallons of fuel in each main tank is prohibited.

Fuel should be used from the main tanks for 60 minutes prior to using fuel from the auxiliary tanks. This is necessary to provide space for auxiliary fuel tank vapors that are returned from the carburetors on aircraft ▲1 ▲2 or fuel-air control unit on aircraft ▲1 through vapor return lines to the main tanks. If sufficient space is not available in the main tanks for this diverted fuel, the tanks may overflow through the filler cap vent hole. Since part of the fuel from the auxiliary tanks is diverted back to the main tanks instead of consumed in the engine, it is not possible to obtain the normal endurance one would expect from 15 gallons of fuel. However, this endurance is regained when this diverted fuel is used from the main tanks. In cold weather flying, sufficient fuel should be retained in the auxiliary tanks to permit operation in the event freezing temperatures are encountered and the main fuel tank system malfunctions. Since the auxiliary tanks are designed for cruising flight, they are not equipped with fuel boost pumps. Under cruising conditions a failure of an engine-driven fuel pump would not be critical because there would be ample time to switch fuel tanks and turn on the fuel boost pumps. However, operation near the ground using auxiliary fuel tanks is not recommended because of these limitations. To assure adequate and rapid resumption of power after running the auxiliary tanks dry and switching to main tanks, it is recommeded that the mixture levers be moved to the FULL RICH position and the fuel bosot pump switches turned ON. During high ambient temperature operations, the fuel boost pumps may be used to correct fuel pressure fluctuations. During rapid climb to higher altitudes, substantial fuel vaporization may occur when fuel has had sufficient time to heat soak during above standard day ground level ambient temperatures. Should vapor volume exceed the vapor separation capacity of the engine-driven fuel pump, fluctuating fuel pressure and unstable engine operation may result. Operation of the fuel boost pumps and manual leaning may be used to stabilize fuel flow until fuel has had sufficient time to cool.

WARNING

Steep bank angles and/or uncoordinated flight maneuvers, while using auxiliary fuel system with less than five (5) gallons of fuel remaining in the auxiliary fuel tanks, may cause engine surging or temporary power loss due to fuel starvation. Surging or complete loss of engine power on the inside of a steep bank turn will cause a rapid increase in bank angle and a nose down attitude, which results in an altitude loss before recovery can be completed.

Note

With the mixture levers in FULL RICH and the boost pumps ON, power will be regained sooner due to faster elimination of vapor from the fuel system.

Return controls to cruise setting after power has been regained.

WARNING

Care should be exercised to place the fuel valves in the detent position. Should the valves be positioned between the MAIN tank and OFF position, fuel starvation will occur above idle rpm.

Note

Should the fuel selectors be positioned between MAIN and AUXILIARY tank positions, there is a possibility of overflowing the auxiliary tanks.

Note

If fuel has siphoned from an auxiliary tank, the tank has probably collapsed and been damaged. Permanent damage to the tank may have resulted and appropriate entry should be made in Form 781 for inspection of the tank and fuel gaging mechanism.

ALTERNATE STATIC SOURCE VALVE OPERATION.

If erroneous instrument readings are suspected due to water or ice in the static pressure lines, the alternate static source valve should be opened. Since this valve vents to the static pressure of the cabin, significant variations in indicated airspeed and altitude occur when it is used in flight. These variations are amplified when the storm window or air vent is open. At cruise speeds the increase above normal indicated airspeed and altitude can vary from 10 mph and 100 feet with the storm window closed, to 27 mph and 260 feet with the storm window open. Due to these variations, the alternate static source should be used primarily as a drain valve to restore the main system or for emergency operation only. When a landing has to be made utilizing the alternate static source, increase indicated altitude and airspeed as shown on the placard in figure 7-1.

Alternate Static Source Placard

IF ALTERNATE STATIC SOURCE IS OPEN
FOR LANDING INCREASE SPEED AND ALTITUDE:

STORM WINDOW CLOSED		STORM WINDOW OPEN	
10 MPH	30 FT	26 MPH	160 FT

Figure 7-1

LANDING GEAR SYSTEM.

For additional information concerning the location of all electrical switches, and electrical and mechanical operation of the landing gear system refer to figure 7-2 for aircraft ▲1, figure 7-3 for aircraft ▲2 ▲3, and figure 7-4 for landing gear emergency handcrank.

BRAKE OPERATION.

To reduce maintenance difficulties and accidents due to wheel brake failure, it is absolutely necessary that aircraft brakes be treated with respect. The most common mistakes that are made that reduce brake life and reliability are stopping the aircraft as quickly as possible regardless of the length of runway; use of brake consistently for speeding up taxiing turns; and dragging brakes while taxiing. When applying brakes, there may be a slight time delay between the pedal release and the release of braking action. To minimize brake wear, the following precautions should be observed insofar as is practicable.

1. In order that brakes can be used as little and as lightly as possible, take full advantage of the length of the runway utilizing aerodynamic braking to stop the aircraft.
2. Use extreme care when applying brakes immediately after touchdown, or at anytime there is considerable lift on the wings, to prevent skidding the tires. Heavy brake pressure will lock the wheels easier immediately after touchdown than when the same pressure is applied after the full weight of the aircraft is on the tires. A wheel once locked in this manner immediately after touchdown will not become unlocked as load increases, as long as brake pressure is maintained. Brakes can stop the wheels from turning, but stopping the aircraft is dependent on the frictional force between the tires and the runway. As the load on the tires increases, the frictional force increases giving better braking action. During a skid, the frictional force is reduced thus requiring more distance to stop.
3. If maximum wheel braking is required, lift should be decreased as much as possible by lowering the the nose gear and raising the flaps before applying brakes. This procedure will improve braking action since the load on the tires will be increased thus increasing the frictional force between the tires and the runway.
4. When a short landing roll is required, a single smooth application of the brakes with constantly increasing pedal pressure will result in optimum braking.
5. During a series of successive landings, a minimum of 15 minutes should elapse between landings where the landing gear remains in the slip stream, and a minimum of 30 minutes between landings with the landing gear retracted, to allow adequate cooling time between brake applications. This time restriction is not applicable to touch-and-go type landings when no brake application is involved.
6. The brakes should not be dragged while taxiing, and should be used as little as possible for turning the aircraft on the ground.
7. At the first indication of brake malfunction, or if brakes are suspected to be in an overheated condition after excessive use, the aircraft should be maneuvered off the active runway and stopped. The aircraft should not be taxied into a crowded parking area and the parking brakes should not be set. Overheated wheels and brakes will be cooled before the aircraft is subsequently towed or taxied. Peak temperatures in the wheel and brake assembly are not attained until approximately five minutes after a maximum braking operation is completed. In extreme cases heat build-up can cause the wheel and tire to fail with explosive force or be destroyed by fire if proper cooling is not effected. Taxiing at low speeds to obtain air cooling of overheated brakes will not reduce temperatures adequately and can actually cause additional heat build-up.

AMMETER CHECK.

During cruise, perform the following operation to determine whether a generator circuit malfunction exists.

Thirty minutes after takeoff, check the ammeter reading. If the reading is high (above 15 amps) there is probably a malfunction in the electrical system; take corrective action as follows:

a. Turn OFF one generator. If the ammeter drops to between 0 and 5 amps, then that voltage regulator is not functioning properly and that generator should be left OFF for the remainder of the flight.

b. If the ammeter remains high, then that voltage regulator is functioning properly and the generator should be turned ON.

c. If the first voltage regulator was functioning properly, repeat step a. above with the second generator.

LANDING GEAR SYSTEM SCHEMATIC▲

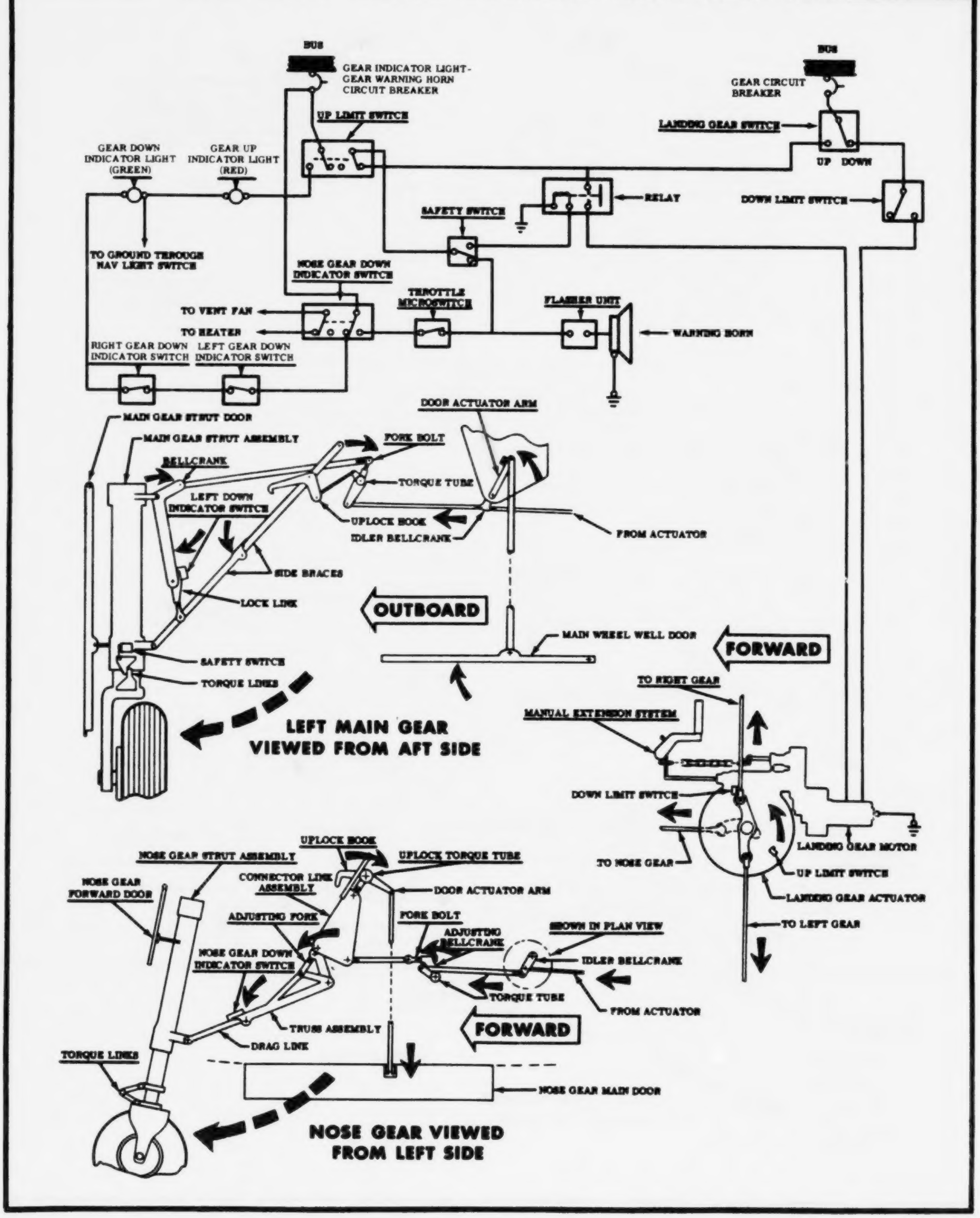

Figure 7-2

LANDING GEAR SYSTEM SCHEMATIC ▲2 ▲3

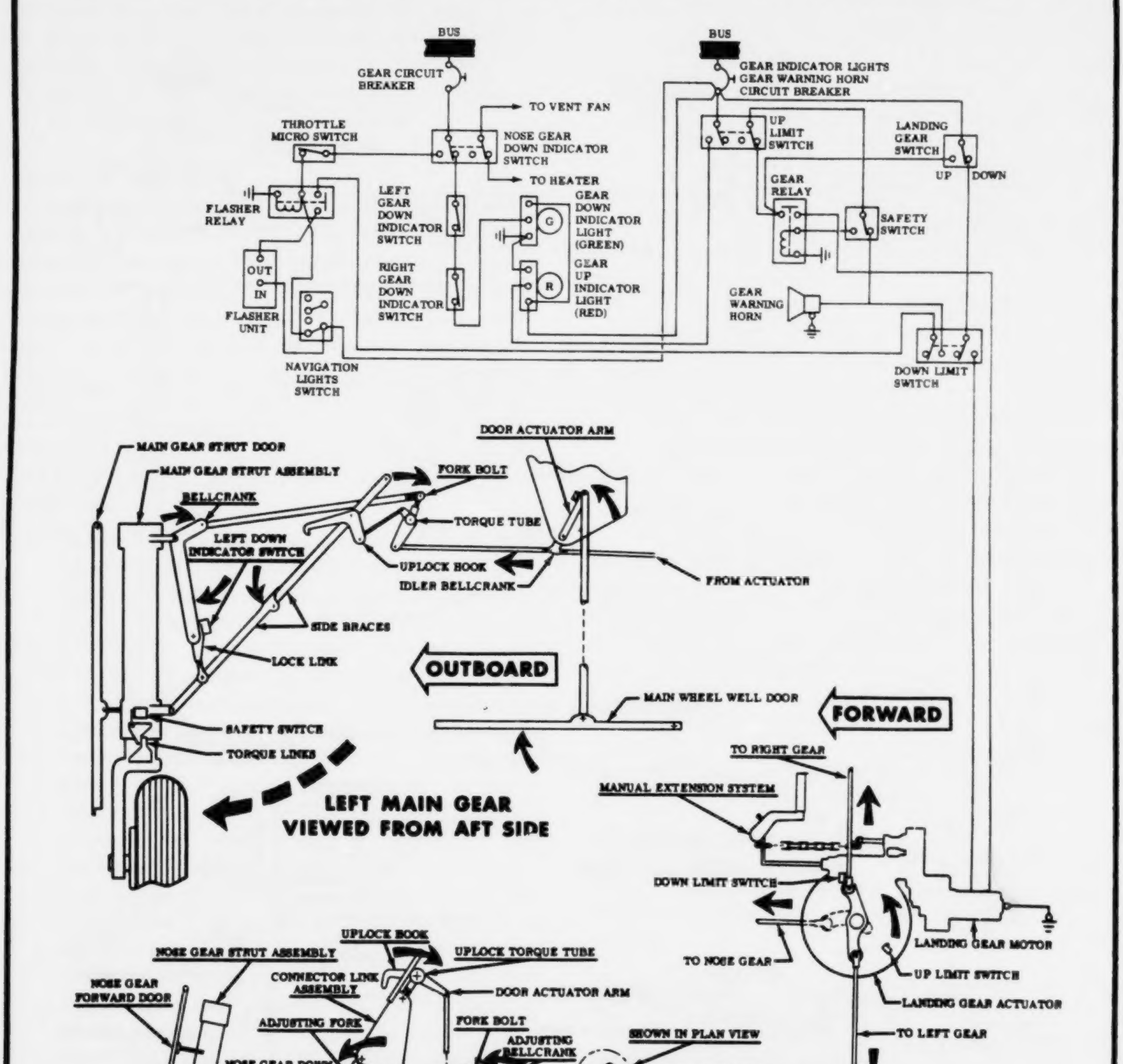

Figure 7-3

LANDING GEAR EMERGENCY HANDCRANK SCHEMATIC

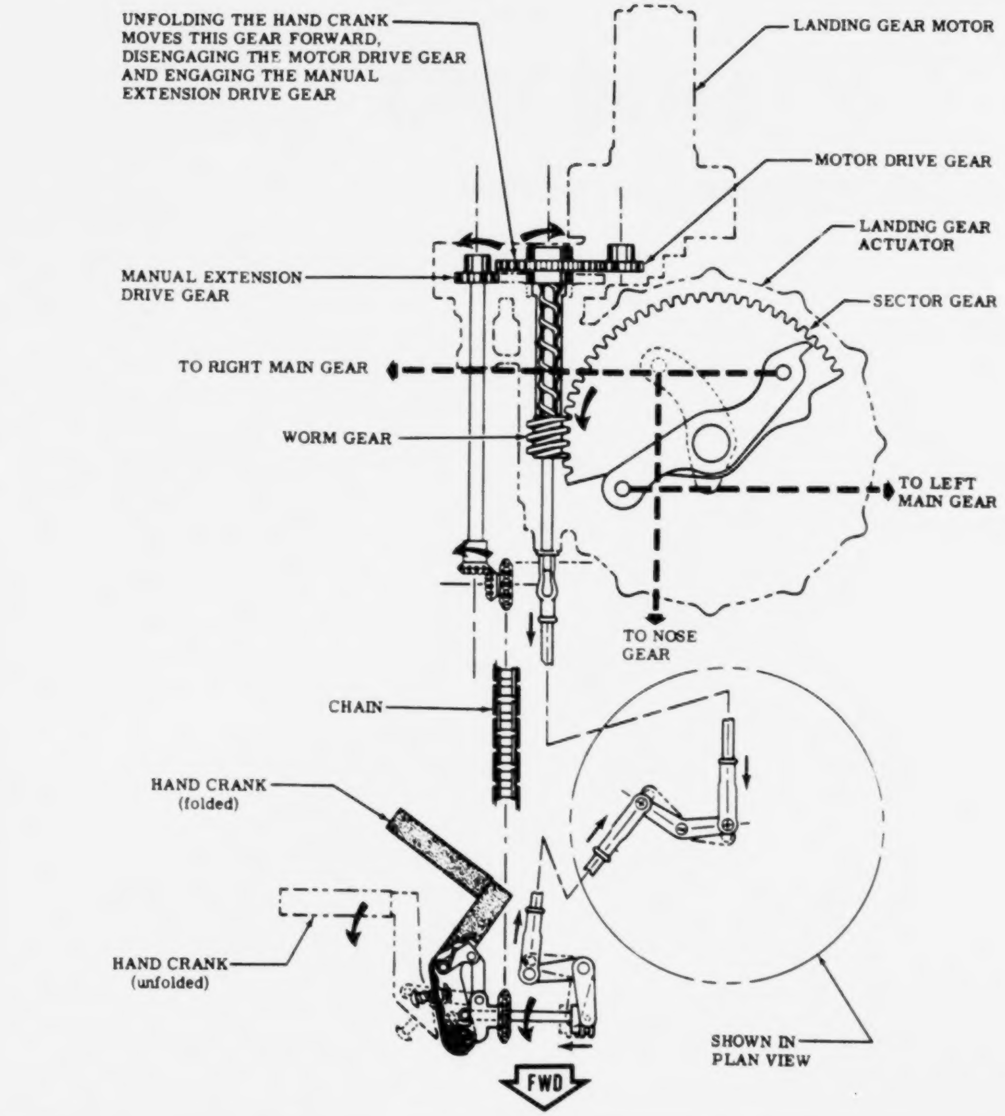

Figure 7-4

Section VIII

CREW DUTIES

Not Applicable to this Aircraft

SECTION IX

ALL WEATHER OPERATION

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Instrument Flight Procedures 9-1
Ice and Rain 9-3
Flight in Turbulence and Thunderstorms 9-4
Cold Weather Procedures 9-4
Hot Weather and Desert Procedures 9-6

INTRODUCTION.

Except where repetition may be necessary for emphasis or continuity of thought this section contains only those procedures and techniques that differ or are in additition to the normal operating instructions covered in other sections. Any discussions relative to system operation are covered in Section VII .

INSTRUMENT FLIGHT PROCEDURES

The following instructions for ALL WEATHER OPERATION Supplement the NORMAL PROCEDURES; therefore, this Section does not include procedures which duplicate those given in Section II, except where necessary for emphasis of continuity.

PRE-FLIGHT.

Complete all normal day and night checks as outlined in Section II, paying particular attention to the operation of flight instruments, ice protection system (if installed), and radio equipment.

INSTRUMENT TAKEOFF AND INITIAL CLIMB.

Procedures for instrument takeoff are essentially the same as for a visual takeoff. Recognize signs of rough engine operation, unequal power between engines, or sluggish engine acceleration early in the takeoff roll under instrument conditions since low visibility may preclude a successful forced landing in the event of an engine malfunction. Any evidence of incorrect engine operation prior to minimum safe single-engine speed (95 mph IAS) is cause for discontinuing the takeoff.

CAUTION

> The rotating beacon light should be turned off during flight through conditions of reduced visibility where the pilot could experience spatial disorientation as a result of the rotating reflections of the light against the clouds.

INSTRUMENT TAKEOFF.

Visually align the aircraft with the runway, then set the miniature aircraft of the attitude indicator to the 90 degree banking indices and the directional indicator to the runway heading. The instrument takeoff is the same as a normal takeoff.

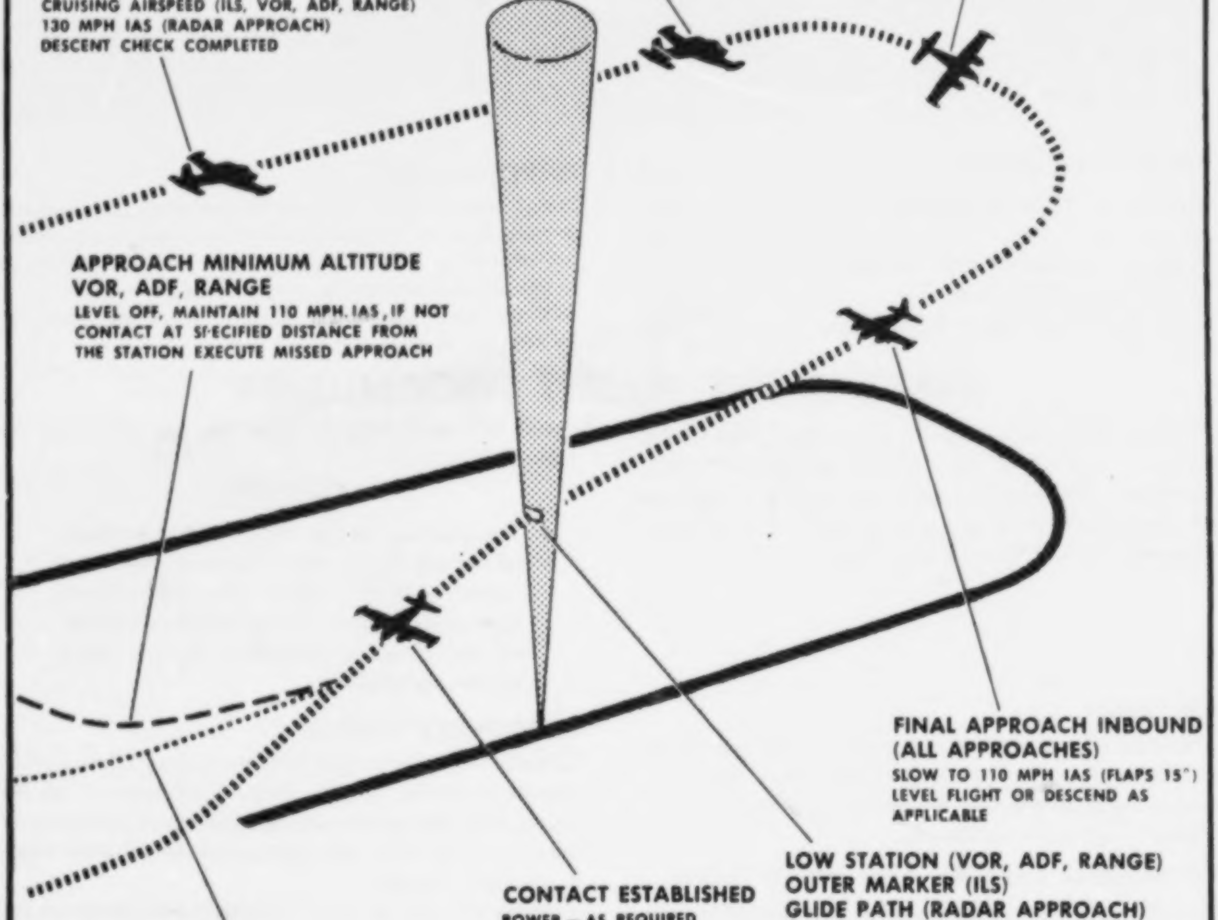
At approximately 80 mph IAS, start back pressure on the control wheel to establish approximately a three bar-widths nose high attitude change on the attitude indicator. With this attitude established, the aircraft will fly off at approximately 95 mph IAS.

Hold this nose-high attitude indication until the altimeter and vertical velocity indicator shows a definite climb. Then raise the landing gear. Reduce power to

Typical INSTRUMENT APPROACH

Note:
This diagram depicts the chronological order of completing the checklist during instrument approaches. The items in the checklist will be completed no later than at the points indicated in the diagram but does not preclude a pilot from accomplishing them at an earlier time.

Note
Fly approach speed in MPH. The knots scale of the airspeed indicator can be referenced to determine the correct time distance from fix to field as shown. To maintain sufficient power for normal temperatures during cold weather operation, the outbound and final approach speeds may be increased 10 MPH.



ENTRY
CRUISING AIRSPEED (ILS, VOR, ADF, RANGE)
130 MPH IAS (RADAR APPROACH)
DESCENT CHECK COMPLETED

OUTBOUND (ILS, VOR, ADF, RANGE)
DOWNWIND (RADAR APPROACH)
SLOW TO 120 MPH IAS (FLAPS 15°)
COMPLETE BEFORE LANDING CHECK
UP TO LANDING GEAR, LEVEL
FLIGHT OR DESCEND AS APPLICABLE

PROCEDURE TURN (ILS, VOR, ADF, RANGE)
BASE LEG (RADAR APPROACH)
POWER — AS REQUIRED TO MAINTAIN
120 MPH IAS, LEVEL FLIGHT OR
DESCEND AS APPLICABLE

APPROACH MINIMUM ALTITUDE
VOR, ADF, RANGE
LEVEL OFF, MAINTAIN 110 MPH IAS, IF NOT
CONTACT AT SPECIFIED DISTANCE FROM
THE STATION EXECUTE MISSED APPROACH

FINAL APPROACH INBOUND
(ALL APPROACHES)
SLOW TO 110 MPH IAS (FLAPS 15°)
LEVEL FLIGHT OR DESCEND AS
APPLICABLE

LOW STATION (VOR, ADF, RANGE)
OUTER MARKER (ILS)
GLIDE PATH (RADAR APPROACH)
BEFORE LANDING CHECK — COMPLETED
(GEAR DOWN)
MAINTAIN 110 MPH IAS
POWER AS REQUIRED FOR DESCENT

CONTACT ESTABLISHED
POWER — AS REQUIRED
FLAPS — AS REQUIRED
LANDING — COMPLETED

APPROACH MINIMUM ALTITUDE
ILS, RADAR APPROACH
IF NOT CONTACT EXECUTE MISSED
APPROACH IN ACCORDANCE WITH
NORMAL GO-AROUND PROCEDURE

Figure 9-1

climb (24 inches Hg and 2450 rpm) when airspeed is above 110 mph IAS. The aircraft will intercept the recommended best climb speed of 130 mph IAS in this nose-high attitude.

INSTRUMENT CLIMB.

Maintain a climb speed of 130 mph IAS up to assigned altitude. Trim the aircraft for "hands-off" flight and use carburetor heat on aircraft ▲ ▲ or induction heat on aircraft ▲ as required.

CAUTION

> The carburetor air knobs on aircraft ▲ ▲ or induction air handles on aircraft ▲ should be set only in HEAT or COLD AIR positions. Do not use any intermediate positions.

INSTRUMENT CRUISE.

The aircraft has satisfactory handling characteristics in smooth air using the published cruise schedule in Appendix I. Turns, using up to 45 degrees angle-of-bank, can be made satisfactorily; however, a maximum of 30 degrees angle-of-bank is recommended for passenger comfort and ease of handling.

HOLDING.

Holding in this aircraft presents no particular problems. Hold at 130 mph IAS. Flaps may be extended to 15 degrees.

INSTRUMENT APPROACHES.

VOR, ADF, RANGE, ILS AND RADAR APPROACHES (TWO ENGINES).

Refer to figure 9-1 for typical approach pattern.

SINGLE-ENGINE APPROACH PROCEDURES.

A single-engine approach is identical to a two-engine approach except that 2600 rpm on aircraft ▲▲ or 2625 rpm on aircraft ▲ will be used, with gear and flaps being extended at low station, glide slope interception or at the pilot's discretion.

ICE AND RAIN

OPERATION IN ICE AND RAIN ▲▲.

WARNING

> Aircraft with wing and horizontal stabilizer deicing systems and propeller anti-icing systems will not be flown into known or forecast moderate icing conditions.

A takeoff should not be attempted if the aircraft is covered with any frost or snow. Because of the lack of full icing-control equipment, ice will normally adhere to the empennage antennas, and windshield. If icing conditions cannot be avoided, the following procedures are recommended:

1. Windshield defrost knob—Full ON.
2. Pitot heat switch—ON.
3. Carburetor air knobs—HEAT positions.

Note

> Change altitude if possible.

If a landing is to be made with ice on the aircraft, make a "power-on" approach at a slightly higher than normal airspeed.

OPERATION IN ICE AND RAIN ▲▲.

WARNING

- A takeoff should not be attempted if the aircraft is covered with any frost or snow.
- Aircraft with wing and horizontal stabilizer deicing systems and propeller anti-icing systems will not be flown into known or forecast moderate icing conditions.

Note

> Avoid flight into areas of icing conditions of any intensity, although trace and light icing may be traversed for a maximum of 30 minutes.

The aircraft is equipped with the necessary wing and horizontal stabilizer de-icing system and propeller anti-icing system to enable the aircraft to fly safety in icing conditions if it becomes necessary. Operation of these systems is described in Section IV. If icing conditions cannot be avoided, the following procedures are recommended.

1. Windshield defrost knob — Full ON.
2. Pitot heat switch — ON.
3. Carburetor air knobs on aircraft ▲ or induction air handles on aircraft ▲ HEAT position.
4. De-icing charge knob — PULL OUT.

Note

> Forces of 30 to 40 pounds may be required to actuate the de-icing charge knob to full extension.

5. De-icing cycle knob — PUSH IN as required.
6. Propeller anti-icing switch — ON.
7. Propeller anti-ice rheostat knob — As required.

Note

> Change altitude if possible.

If a landing is to be made with ice on the aircraft, make a "power on" approach at a slightly higher than normal airspeed.

FLIGHT IN TURBULENCE AND THUNDERSTORMS

CAUTION

Do not fly into areas of known or forecast turbulence which exceeds moderate intensity.

OPERATION IN TURBULENT AIR.

If turbulence is encountered, operate the aircraft at **140** to **150** mph IAS. Thunderstorm flying is not recommended because of the difficulty in controlling the aircraft. However, some operations require flights near thunderstorm areas. If such is the case, the following precautionary measure should be taken:

APPROACHING THE STORM.

Prior to entering a zone of turbulent air, prepare the aircraft as follows:

1. Pitot heat—ON.
2. Carburetor air knobs aircraft ▲ ▲ or induction air handles aircraft ▲ HEAT position.
3. Power—As required to maintain desired penetration speed.
4. Instruments—Check for proper operation.
5. Safety belt—Fastened and tight (passengers and pilot).
6. Cockpit lights—At night turn on all to full intensity to minimize blinding effects of lightning. ETA's for several check points ahead should be computed.

CAUTION

Do not lower gear or flaps because maximum allowable flap or gear speed may be inadvertently exceeded in heavy turbulence and damage to the landing gear system may result.

IN THE STORM.

Maintain power setting and pitch attitude (established before entering the storm) throughout the storm. Hold these constant and airspeed will be essentially constant, regardless of the reading of the airspeed indicator.

Devote all your attention to flying the aircraft.

You can expect turbulence, precipitation, and lightning; don't allow them to cause undue concern. Maintain attitude, concentrate on holding a level attitude by reference to the attitude indicator.

Maintain your original heading. Do not make turns unless absolutely necessary. Don't chase airspeed. Doing so will result in extreme pitch attitudes. A heavy rain, by partially blocking the pitot tube pressure head, may cause erratic fluctuations of the airspeed indicator.

Use as little elevator control as possible to maintain attitude in order to minimize stresses on the aircraft.

The altimeter may be unreliable in thunderstorms due to the differential barometric pressures within the storm. A gain or loss in excess of a thousand feet may be expected. Make allowance for this error in determining minimum safe altitude.

Note

Normally, the least turbulent areas in a thunderstorm will be at an altitude of from zero to 6,000 feet above the terrain. Altitudes between 10,000 and 20,000 feet are usually the most turbulent.

COLD WEATHER OPERATION

OPERATION IN COLD WEATHER.

For cold weather operation winterization baffles covering 60 per cent of the cooling air inlets of each nacelle are easily installed or removed on the ground. The winged fasteners employed to secure the baffles can be actuated by hand and no tools are necessary.

CAUTION

With engine baffles installed high oil temperature and low oil pressure may result during operation at high power and low air speed at high ambient temperature conditions.

Note

The baffles must be removed from the aircraft prior to takeoff when outside air temperature is above 20° F.

During cold weather operation these baffles serve a dual purpose. First, the restricted cooling air flow aids in maintaining adequate engine operating temperatures. Secondly, the intake air temperature is raised, thereby improving fuel vaporization and decreasing the possibility of rough engine operation.

BEFORE ENTERING AIRCRAFT.

1. Remove protective covers from cockpit and pitot head.
2. Remove snow and ice from control surfaces, wings, control hinges, fuel tank vents, pitot static sources, and fuel boost pump drain opening.

3. Perform exterior inspection.
4. Preheat engine compartment when possible by using portable ground heater with engine cover in place.
5. Fill oil tank with preheated oil to which one quart of gasoline has been added.
6. Remove engine cover.
7. With ignition switch OFF, pull propeller through several revolutions by hand.

ON ENTERING THE AIRCRAFT.

Refer to Section II and perform Interior Inspection.

BEFORE STARTING ENGINES.

Refer to Section V for normal operating limits.

STARTING ENGINES.

The starting procedure is normal, although additional priming will probably be required.

WARM-UP AND GROUND TEST.

If external pre-heat is not available and rough engine operation is encountered due to inadequate fuel vaporization, the engines should be allowed to warm-up using full carburetor heat on aircraft ▲1 ▲2 or induction heat on aircraft ▲3.

WARNING

> In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

An oil temperature indication is not necessary if after a suitable warm-up period the engines accelerate smoothly and oil pressure remains normal and steady, the aircraft is ready for takeoff. If the oil pressure remains below 30 psi after sufficient run-up, the engine should be shut down and investigated.

TAXIING.

Avoid taxiing in deep snow or slush as steering will be extremely difficult and frozen brakes may result. Extreme caution should be exercised when taxiing on hard snow or ice and taxi speed should be very slow. This will eliminate the necessity of braking which could result in skidding or possible loss of control. Use only essential electrical equipment to preserve battery life when taxiing at low engine speed.

BEFORE TAKEOFF.

The engines should accelerate smoothly and oil pressure should remain normal and steady. The propellers should be operated through several complete cycles to warm the oil in the governor and propeller hub. If carburetor heat on aircraft ▲1 ▲2 or induction heat on aircraft ▲3 is necessary for smooth engine operation during warm-up, the carburetor air knobs on aircraft ▲1 ▲2 or induction air handles on aircraft ▲3 should be returned to the full COLD position prior to application of full power.

TAKEOFF.

Takeoff procedures are normal in all respects.

WARNING

> Takeoff will not be made if there is any frost, snow or ice on the wings as dangerous loss of lift may result.

DURING FLIGHT.

WARNING

> Do not fly aircraft ▲1 ▲2 not modified per T. O. 1U-3A -519, into known or forecast icing conditions.

1. Full carburetor heat on aircraft ▲1 ▲2 or induction heat on aircraft ▲3 should be utilized as required to maintain smooth engine operation.
2. The propellers should be exercised at half-hour intervals to flush the cold oil from the governor and propeller hub.
3. Electrical equipment should be managed to assure adequate generator charging throughout the flight.
4. Sufficient fuel should be retained in the auxiliary tanks to permit emergency operation in the event freezing temperatures are encountered and the main fuel tank system malfunctions.

CAUTION

> Congealed oil can normally be detected by low oil pressure and high oil temperature when operating in sub-zero temperatures. In the event oil should congeal in the oil cooler either during takeoff or while cruising in sub-zero temperatures, the following procedure is recommended: at a safe altitude, lower landing gear and flaps (below maximum gear extended speed). Set rpm at 2450 and apply sufficient manifold pressure to maintain 110 mph IAS. This will reduce air flow through the oil cooler while increasing engine operating temperatures, thereby allowing the oil to become warmer and flow freely. If the oil pressure and temperature do not return to normal within five minutes, land as soon as possible.

DESCENT.

Use power in let downs to maintain proper engine temperatures. Carburetor heat on aircraft ▲▲ or induction heat on aircraft ▲ may be used if engine roughness develops during let downs.

APPROACH TO PATTERN.

1. Avoid engine over cooling in the approach.
2. Carburetor air knobs on aircraft ▲▲ or induction air knobs on aircraft ▲—COLD (except in known icing conditions).

LANDING.

When landing on runways covered with ice or snow, avoid leaving wing flaps down after landing. Use brakes only when necessary on landing roll.

STOPPING THE ENGINES.

Stopping is normal except when a very cold start without external engine preheat is anticipated. Under these conditions the oil dilution system should be utilized as follows:

Note

Avoid excessive oil dilution by specifically following the instructions listed on the placard. Avoid indiscriminate or unnecessary use of oil dilution. Due to the thinning and washing properties of the diluting process, it is strongly advised that after the first dilution process of the season, the oil be drained and replaced with fresh oil. The washing action of the gasoline has a tendency to loosen sludge which is detrimental to continued engine operation.

1. Throttles — 1000 rpm.
2. Fuel boost pump switches — ON.
3. Oil dilution switch — Hold to L then to R. Oil temperature must be below 122° F before starting engine dilution.

Note

At 1000 rpm fuel will flow into the oil system at the rate of one quart every 90 seconds. Holding the switches for three minutes will normally provide adequate oil dilution for cold weather starts. With the oil at its normal 11 quart level, the switch may be held for a maximum of seven and one half minutes without the oil sumps overflowing.

Dilute engine oil in accordance with the following schedule:

Grade 1065 Time in Seconds	Anticipated Temperature in Degrees F.	Grade 1100 Time in Seconds
	30	40
	20	70
30	10	120
70	0	160
120	−10	220
170	−20	280
230	−30	350
310	−40	440*
400*	−50	

*Dilution over 360 seconds requires one quart of oil to be drained from the normal 12 quart capacity for each 90 seconds exceeding 360 seconds. Dilution over 30% (ie 480 seconds/8 minutes) is not recommended.

CAUTION

Dilution will cause a false indication of usable oil on the dipstick. Care should be exercised to aviod over-dilution, since the engine sump capacity is 12 quarts. With a total diluted oil volume of 16 quarts, the engine may discharge an excessive amount of oil in an extreme nose up or nose down flight condition.

BEFORE LEAVING THE AIRCRAFT.

CAUTION

Do not set the parking brakes since the brakes may freeze in the ON position.

Drain the engine oil if it has not been diluted. Inspect the fuel and oil vents and remove any ice. Fill the fuel tanks to avoid condensation and drain all fuel drains of condensate.

HOT WEATHER AND DESERT PROCEDURES

No special instructions have been prepared to cover hot weather or desert conditions except that the use of the fuel boost pumps may be necessary to eliminate vapor lock during ground and in-flight operation.

APPENDIX I • SECTION 1

PERFORMANCE DATA

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GENERAL.

The Appendix I is provided so that the entire mission may be planned before takeoff. The charts in this section provides the pilot with the performance that can be expected for all normal and emergency conditions. The Appendix I is divided into two sections, Section 1 (pages numbered A1-) is denoted to the U-3A aircraft (▲▲▲) and Section 2 (pages numbered A2-) is denoted to the U-3B aircraft (▲). The sections are sub-divided into parts, with each part describing a segment of the mission.

DISCUSSION OF CHARTS.

The data presented in Appendix I is taken from actual flight test measurements. Density altitude is used as the primary presentation method, however, the takeoff, climb, and landing charts include graphs for converting temperature and pressure altitude to density altitude.

ATMOSPHERIC DATA.

Figure A1-1-1 is provided so that density altitude may be obtained from temperature and pressure altitude. Pressure altitude is the altimeter reading with the pressure dial set at 29.92 inches Hg.

AIRSPEED SYSTEM ERROR.

In order to determine airspeed it is necessary to measure both the impact pressure of the air and the ambient (static) pressure of the air mass surrounding the aircraft. The impact pressure is measured by the pitot head on the nose of the aircraft and the ambient pressure by the static pressure ports on the side of the fuselage. It is difficult to measure both quantities accurately because they change with angle of attack and with configuration of the aircraft.

The difference between the correct airspeed and the indicated airspeed is known as the position error and has been determined for aircraft ▲▲,▲ and aircraft ▲. The position error in aircraft ▲▲▲ is shown in figure A1-1-3 and for aircraft ▲ in figure A2-1-3.

AIRSPEED TERMINOLOGY.

The airspeed as read from the airspeed indicator is indicated airspeed (IAS). Calibrated airspeeds (CAS) is indicated airspeed corrected for position error and mechanical error in the indicator. The error in the indicator is normally small and not available to the pilot. It is therefore considered to be zero throughout this manual. True airspeed (TAS) is the speed of the aircraft relative to its surrounding air mass. True airspeed is equal to ground speed when there is no wind. True airspeed is found by dividing calibrated airspeed by the square root of the density ratio ($\sqrt{\sigma}$) from figure A1-1-1 for any particular density altitude. At a density altitude of sea level true airspeed equals calibrated airspeed.

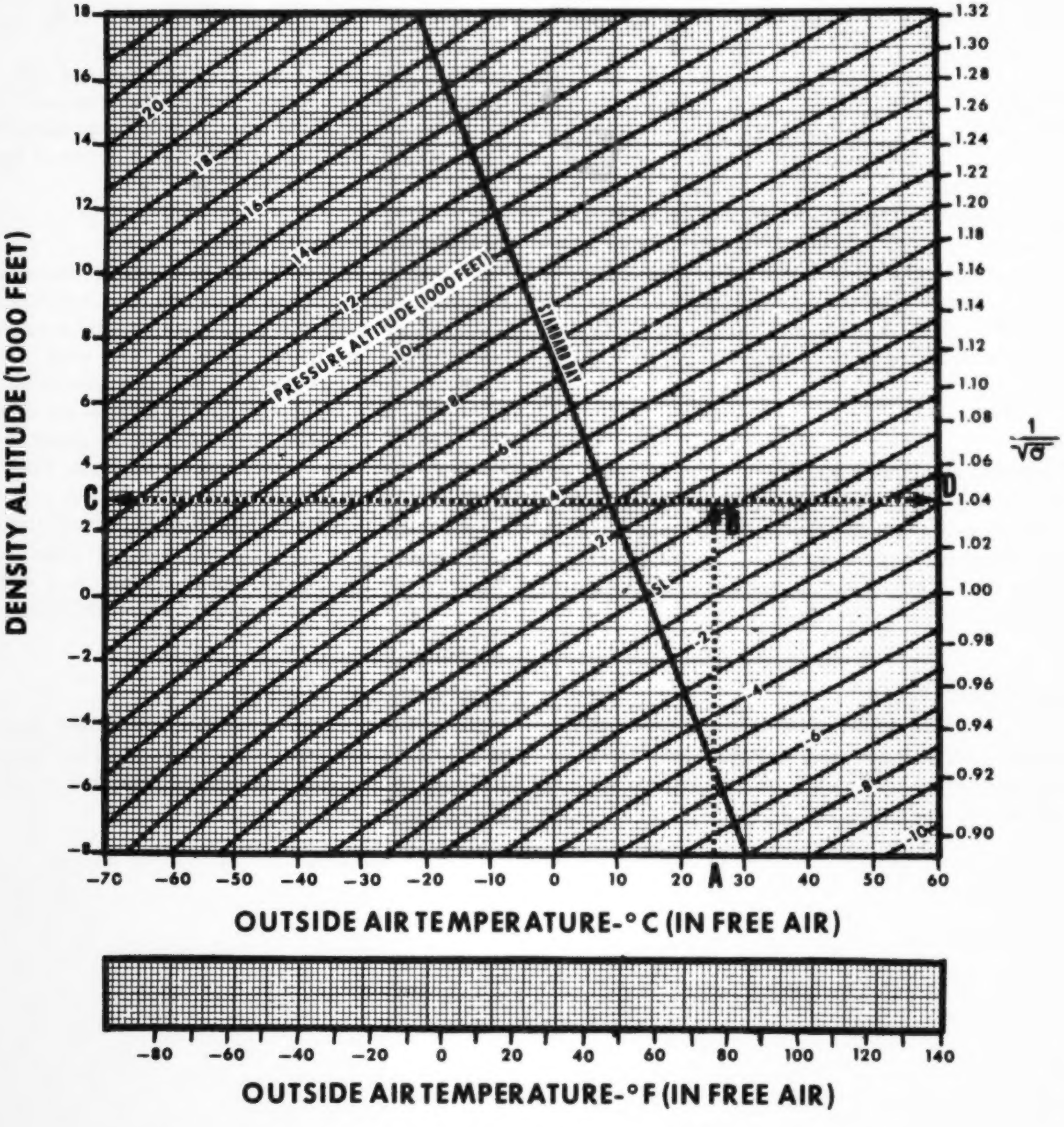
CONVERSION CHARTS.

Figure A1-1-2 is used to convert temperature from °F to °C and speed from mph to knots. This figure is included to simplify conversions from one system to another.

DENSITY ALTITUDE CHART

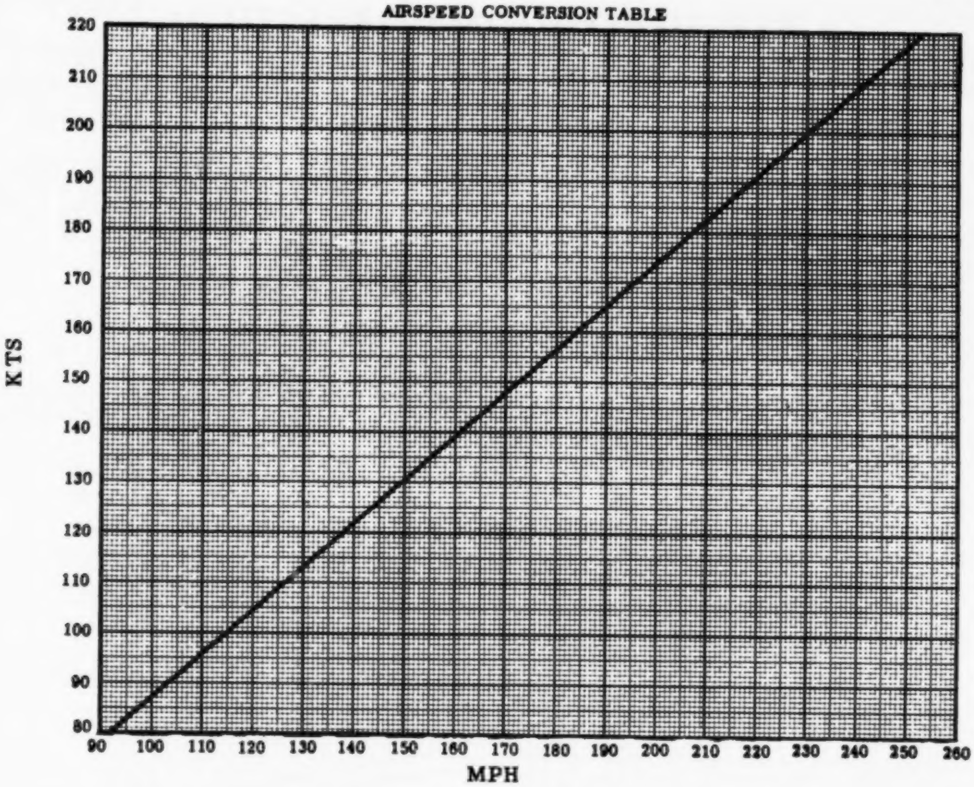
EXAMPLE

(A) IF AMBIENT TEMPERATURE IS 25°C AND (B) PRESSURE ALTITUDE IS 1500 FEET, (C) THE DENSITY ALTITUDE IS 3000 FEET AND (D) $\frac{1}{\sqrt{\sigma}}$ IS 1.042



NOTE: TO FIND STANDARD DAY TEMPERATURE, FOLLOW STANDARD DAY LINE TO PRESSURE ALTITUDE, THEN READ STRAIGHT DOWN TO TEMPERATURE SCALE

Figure A1-1-1



AIRSPEED CONVERSION TABLE

TEMPERATURE CONVERSION TABLE

° Cent.	° Fahr.	° Cent.	°Fahr.	° Cent.	° Fahr.	° Cent.	° Fahr.	° Cent.	° Fahr.	° Cent.	° Fahr.
-50	-58.0	-25	-13.0	0	32.0	25	77.0	50	122.0	75	167.0
-49	-56.2	-24	-11.2	1	33.8	26	78.8	51	123.8	76	168.8
-48	-54.4	-23	-9.4	2	35.6	27	80.6	52	125.6	77	170.6
-47	-52.6	-22	-7.6	3	37.4	28	82.4	53	127.4	78	172.4
-46	-50.8	-21	-5.8	4	39.2	29	84.2	54	129.2	79	174.2
-45	-49.0	-20	-4.0	5	41.0	30	86.0	55	131.0	80	176.0
-44	-47.2	-19	-2.2	6	42.8	31	87.8	56	132.8	81	177.8
-43	-45.4	-18	- .4	7	44.6	32	89.6	57	134.6	82	179.6
-42	-43.6	-17	1.4	8	46.4	33	91.4	58	136.4	83	181.4
-41	-41.8	-16	3.2	9	48.2	34	93.2	59	138.2	84	183.2
-40	-40.0	-15	5.0	10	50.0	35	95.0	60	140.0	85	185.0
-39	-38.2	-14	6.8	11	51.8	36	96.8	61	141.8	86	186.8
-38	-36.4	-13	8.6	12	53.6	37	98.6	62	143.6	87	188.6
-37	-34.6	-12	10.4	13	55.4	38	100.4	63	145.4	88	190.4
-36	-32.8	-11	12.2	14	57.2	39	102.2	64	147.2	89	192.2
-35	-31.0	-10	14.0	15	59.0	40	104.0	65	149.0	90	194.0
-34	-29.2	- 9	15.8	16	60.8	41	105.8	66	150.8	91	195.8
-33	-27.4	- 8	17.6	17	62.6	42	107.6	67	152.6	92	197.6
-32	-25.6	- 7	19.4	18	64.4	43	109.4	68	154.4	93	199.4
-31	-23.8	- 6	21.2	19	66.2	44	111.2	69	156.2	94	201.2
-30	-22.0	- 5	23.0	20	68.0	45	113.0	70	158.0	95	203.0
-29	-20.2	- 4	24.8	21	69.8	46	114.8	71	159.8	96	204.8
-28	-18.4	- 3	26.6	22	71.6	47	116.6	72	161.6	97	206.6
-27	-16.6	- 2	28.4	23	73.4	48	118.4	73	163.4	98	208.4
-26	-14.8	- 1	30.2	24	75.2	49	120.2	74	165.2	99	210.2

Figure A1-1-2

AIRSPEED POSITION CORRECTION

MODEL: U-3A

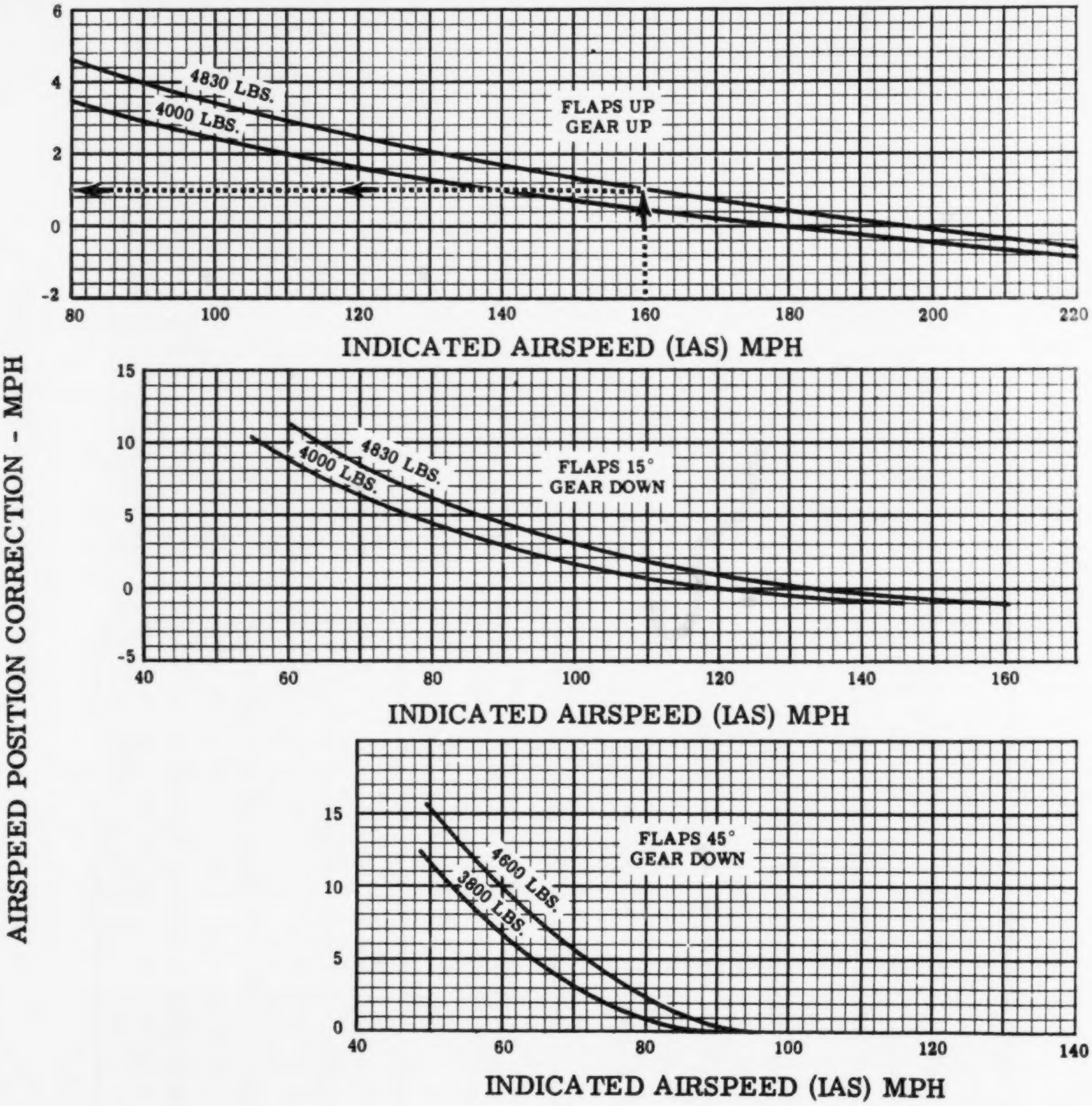
DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

ENGINES (2) : O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LBS/GAL.



NOTE: ADD AIRSPEED POSITION CORRECTION TO IAS TO OBTAIN CAS.

Figure A1-1-3

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INTRODUCTION.

Aircraft ▲ ▲ ▲ are powered by Continental O-470-M engines rated at 240 brake horsepower at 2600 rpm. The engines are not supercharged and have no manifold pressure restrictions for takeoff and climb. The maximum recommended cruise power is 180 BHP or 2450 rpm and 24 inches Hg. The mixture should be leaned using the technique described in Section VII:

DISCUSSION OF CHARTS.

ENGINE OPERATING LIMITS

(See figure A1-2-1) The Engine Operating Limits Chart is supplied by the engine manufacturer and is used to find the power delivered by the engine when manifold pressure, RPM, temperature, and density altitude are known.

EXAMPLE: (See figure A1-2-1)

Known:

1. **Manifold pressure = 25 inches Hg.**
2. **RPM = 2500**
3. **Density altitude = 1000 feet**
4. **Ambient temperature = 19°C**

Find:

1. **Brake horsepower delivered by the engine**

Solution:

1. **Locate point A on Altitude portion at intersection of 2500 RPM and 25 inches Hg.**
2. **Locate point B on Sea Level portion at 2500 RPM and 25 inches Hg.**
3. **Transfer to point C at sea level brake horsepower (192 BHP)**
4. **Draw straight line between points C and A**
5. **Read standard day brake horsepower at 1000 feet density altitude = 194 BHP**
6. **Find standard day temperature at 1000 feet density altitude (on lower section of Altitude Performance portion) = 13°C**
7. **Find difference between actual and standard day temperature: 19°C — 13°C = 6°C**
8. **Find per cent power change because of non-standard temperature** $\frac{6^\circ C}{6^\circ C} = 1\%$
9. **Find power change because of non-standard temperature: 194 BHP × 0.01 = 1.94 BHP**
10. **Since ambient temperature is above standard then actual BHP = 194 BHP — 1.94 BHP = 192 BHP**

    NOTE: If ambient temperature is less than standard temperature, the brake horsepower change is added to the power at standard temperature.

POWER SCHEDULE CHARTS

(See figures A1-2-2 thru A1-2-7)

Power Schedules are included in tabular form in figure A1-2-2 through A1-2-7 from the rated horsepower down to 80 brake horsepower in 20 BHP increments for aircraft ▲ ▲ ▲. These schedules show typical settings required for engine rpm and manifold pressure at various pressure altitudes and outside air temperatures. Fuel consumption data for twin-engine operation is also included and is shown for full rich mixture at power of 180 BHP to 240 BHP (75% to 100% power) and for mixture leaned to approximate best power mixture for 180 BHP and below. For mixture leaning technique, refer to Section VII. Bracket lines across the charts show the division lines for various engine speeds. In using these charts, the manifold pressure and fuel flow are read directly opposite the pressure altitude. However, the required engine rpm is read within the bracketed area where necessary. Although the data may be interpolated between charts for intermediate powers, a convenient approximation has been derived as an alternate method. Under given conditions at a given rpm, a change in manifold pressure of 0.1 inch results in a change in power of one BHP. Therefore, if the power setting is obtained for a BHP nearest to that desired, then the above factor may be used for minor variations.

EXAMPLE: (See figure A1-2-2)

Known:

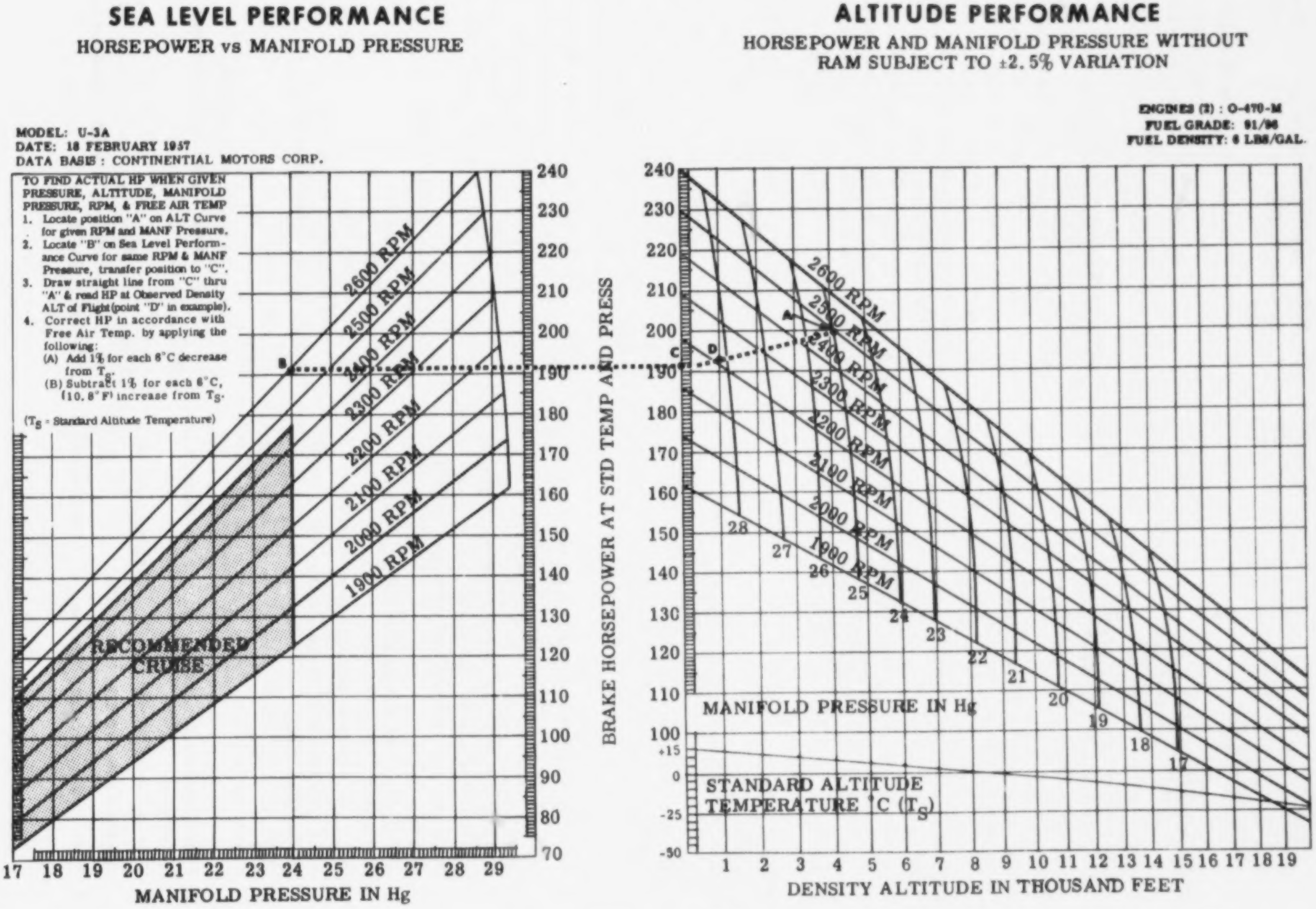
BHP = 180
Mixture = Full rich
Pressure altitude = 6,000 feet
Outside air temperature = 20°C

Find:

Fuel flow = 37.9 GHP (two engines)
Manifold pressure = 22.6 inches mercury
RPM = 2600

If the desired horsepower had been 185, then the manifold pressure should be increased by 0.5 of an inch (0.1 × 5 BHP) to 23.1 inches.

ENGINE OPERATING LIMITS



MODEL: U-3A
DATE: 18 FEBRUARY 1957
DATA BASIS : CONTINENTIAL MOTORS CORP.

TO FIND ACTUAL HP WHEN GIVEN PRESSURE, ALTITUDE, MANIFOLD PRESSURE, RPM, & FREE AIR TEMP

1. Locate position "A" on ALT Curve for given RPM and MANF Pressure.
2. Locate "B" on Sea Level Performance Curve for same RPM & MANF Pressure, transfer position to "C".
3. Draw straight line from "C" thru "A" & read HP at Observed Density ALT of Flight (point "D" in example).
4. Correct HP in accordance with Free Air Temp. by applying the following:
   - (A) Add 1% for each 6°C decrease from T_S.
   - (B) Subtract 1% for each 6°C, (10.8°F) increase from T_S.

(T_S = Standard Altitude Temperature)

ENGINES (2) : O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

Figure A1-2-1

MODEL: U-3A

DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

POWER SCHEDULE–240 TO 180 BHP

MIXTURE: FULL RICH

ENGINES (2) : O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LBS/GAL.

BHP/ Eng.	Press. Alt. (Ft.)	Fuel Flow (Gal/Hr) 2 Eng.	Manifold Pressure (In. Hg.)									RPM
			Outside Air Temperature (°C)									
			-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	
240	S. L.	43.0	26.7	27.2	27.6	28.0	28.4					2600
	1000	45.1	26.6	27.0	27.5							2600
220	S. L.	37.2	25.0	25.3	25.7	26.1	26.5	26.9	27.2	27.5	27.9	2600
	1000	39.1	24.9	25.2	25.6	26.0	26.4	26.8	27.1	27.4		2600
	2000	41.0	24.8	25.1	25.5	25.9	26.3	26.7				2600
	3000	43.0	24.7	25.0	25.4	25.8						2600
	4000	44.9	24.5	24.9								2600
200	S. L.	32.6	23.1	23.5	23.9	24.2	24.6	24.9	25.3	25.6	25.9	2600
	1000	34.3	23.0	23.4	23.7	24.1	24.5	24.8	25.1	25.5	25.8	2600
	2000	36.0	22.9	23.3	23.6	23.9	24.3	24.7	25.0	25.3	25.7	2600
	3000	37.7	22.8	23.2	23.5	23.8	24.2	24.6	24.9			2600
	4000	39.4	22.7	23.1	23.4	23.7	24.0	24.4	24.8			2600
	5000	41.2	22.6	23.0	23.3	23.6	23.9					2600
	6000	42.9	22.5	22.9	23.2							2600
180	S. L.	28.8	22.7	23.0	23.4	23.7	24.0	24.3	24.7	25.0	25.3	2450
	1000	30.3	22.6	22.9	23.3	23.6	23.9	24.2	24.6	24.9	25.2	2450
	2000	31.8	22.5	22.8	23.2	23.5	23.8	24.1	24.5	24.8	25.1	2450
	3000	33.3	22.4	22.7	23.0	23.4	23.7	24.0	24.4	24.7	25.0	2450
	4000	34.9	22.3	22.6	22.9	23.3	23.6	23.9	24.3	24.6	24.9	2450
	5000	36.3	22.2	22.5	22.8	23.2	23.5	23.8	24.1	23.0	23.3	2600
	6000	37.9	22.1	22.4	22.7	23.1	23.4	22.3	22.6	22.9	23.1	2600
	7000	39.4	22.0	22.3	22.6	21.6	21.9	22.2				2600
	8000	40.9	20.6	20.9	21.2	21.5						2600
	9000	42.4	20.4	20.8								

NOTES:

(1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
(2) THE CHART ALLOWS FOR AN AVERAGE CARBURETOR AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
(3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

PROCEDURE:

READ FUEL FLOW AND MANIFOLD PRESSURE DIRECTLY OPPOSITE ALTITUDE. READ ENGINE RPM WITHIN BRACKETED AREAS.

Figure A1-2-2

POWER SCHEDULE–180 AND 160 BHP

MIXTURE: APPROXIMATE BEST POWER

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

ENGINES (2) : 0-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

BHP/ Eng.	Press. Alt. (Ft.)	Fuel Flow (Gal/Hr) 2 Eng.	Manifold Pressure (In. Hg.)									RPM
			Outside Air Temperature (°C)									
			-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	
180	S. L.	26.6	22.7	23.0	23.4	23.7	24.0	24.3	24.7	25.0	25.3	2450
	1000	26.6	22.6	22.9	23.3	23.6	23.9	24.2	24.6	24.9	25.2	2450
	2000	26.6	22.5	22.8	23.2	23.5	23.8	24.1	24.5	24.8	25.1	2450
	3000	26.6	22.4	22.7	23.0	23.4	23.7	24.0	24.4	24.7	25.0	2450
	4000	26.6	22.3	22.6	22.9	23.3	23.6	23.9	24.3	24.6	24.9	2450
	5000	26.6	22.2	22.5	22.8	23.2	23.5	23.8	24.1	23.0	23.3	2600
	6000	26.6	22.1	22.4	22.7	23.1	23.4	22.3	22.6	22.9	23.1	2600
	7000	26.6	22.0	22.3	22.6	21.6	21.9	22.2				2600
	8000	26.6	20.6	20.9	21.2	21.5						2600
	9000	26.6	20.4	20.8								2600
160	S. L.	23.9	22.2	22.5	22.8	23.1	23.4	23,7	24.0	24.3	24.6	2300
	1000	23.9	22.0	22.3	22.6	22.9	23.2	23.5	23.8	24.1	24.4	2300
	2000	23.9	21.9	22.2	22.5	22.8	23.1	23.4	23.7	24.0	24.3	2300
	3000	23.9	21.8	22.1	22.4	22.7	23.0	23.3	23.6	23.9	24.2	2300
	4000	23.9	21.6	22.0	22.3	22.6	22.9	23.2	23.5	23.8	24.1	2300
	5000	23.9	21.5	21.8	22.1	22.4	22.7	23.0	23.4	23.7	24.0	2300
	6000	23.9	21.4	21.7	22.0	22.3	22.6	22.9	23.2	23.6	22.5	2450
	7000	23.9	21.3	21.5	21.8	22.1	22.5	21.5	21.8	22.1	22.4	2450
	8000	23.9	21.2	21.4	21.7	20.8	21.1	21.4	21.7	20.7	20.9	2600
	9000	23.9	19.8	20.1	20.4	20.7	21.0	20.0	20.3	20.6		2600
	10000	23.9	19.7	20.0	19.0	19.3	19.6	19.9				2600
	11000	25.1	18.4	18.7	18.9	19.1						2600
	12000	26.7	18.3									2600

NOTES:

(1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
(2) THE CHART ALLOWS FOR AN AVERAGE CARBURETOR AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
(3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

PROCEDURE:

READ FUEL FLOW AND MANIFOLD PRESSURE DIRECTLY OPPOSITE ALTITUDE. READ ENGINE RPM WITHIN BRACKETED AREAS.

Figure A1-2-3

MODEL: U-3A

DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

POWER SCHEDULE–140 BHP

MIXTURE: APPROXIMATE BEST POWER

ENGINES (2): O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LBS/GAL.

BHP/ Eng.	Press. Alt. (Ft.)	Fuel Flow (Gal/Hr) 2 Eng.	Manifold Pressure (In. Hg.)									RPM
			Outside Air Temperature (°C)									
			-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	
140	S. L.	21.4	21.1	21.4	21.7	22.0	22.3	22.6	22.9	23.2	23.5	2200
	1000	21.4	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.0	23.3	2200
	2000	21.4	20.9	21.2	21.5	21.8	22.1	22.4	22.7	23.9	23.2	2200
	3000	21.4	20.8	21.1	21.4	21.7	22.0	22.3	22.6	23.8	23.1	2200
	4000	21.4	20.7	21.0	21.3	21.6	21.8	22.1	22.3	22.6	22.9	2200
	5000	21.4	20.5	20.8	21.1	21.4	21.7	22.0	22.2	22.4	22.7	2200
	6000	21.4	20.3	20.7	20.9	21.2	21.5	21.8	22.1	22.3	22.6	2200
	7000	21.4	20.2	20.5	20.8	21.1	21.4	21.7	22.0	22.2	22.5	2200
	8000	21.4	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.1	21.3	2300
	9000	21.4	20.0	20.3	20.6	20.9	21.2	20.4	20.7	21.0	21.2	2300
	10000	21.4	19.8	20.2	20.5	19.7	20.0	20.3	19.4	19.6		2450
	11000	22.1	18.8	19.0	19.3	19.6	18.7	19.0	19.3	18.3		2600
	12000	23.0	18.7	17.8	18.1	18.4	18.6	17.7	18.0	18.2		2600
	13000	24.1	17.4	17.7	18.0	16.9	17.2	17.6				2600
	14000	25.4	17.3	16.4	16.7	17.0						2600
	15000	26.9	16.0	16.3								2600

NOTES:

(1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
(2) THE CHART ALLOWS FOR AN AVERAGE CARBURETOR AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
(3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

PROCEDURE:

READ FUEL FLOW AND MANIFOLD PRESSURE DIRECTLY OPPOSITE ALTITUDE. READ ENGINE RPM WITHIN BRACKETED AREAS.

Figure A1-2-4

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

POWER SCHEDULE–120 BHP

MIXTURE: APPROXIMATE BEST POWER

ENGINES (2) : O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

BHP/ Eng.	Press. Alt. (Ft.)	Fuel Flow (Gal/Hr) 2 Eng.	Manifold Pressure (In.Hg.)									RPM
			Outside Air Temperature (°C)									
			-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	
120	S. L.	19.0	19.1	19.4	19.7	19.9	20.1	20.4	20.6	20.8	21.1	2200
	1000	19.0	19.0	19.3	19.6	19.8	20.0	20.3	20.5	20.7	20.9	2200
	2000	19.0	18.8	19.1	19.4	19.6	19.8	20.1	20.4	20.6	20.7	2200
	3000	19.0	18.7	19.0	19.2	19.4	19.6	19.9	20.2	20.5	20.6	2200
	4000	19.0	18.5	18.8	19.0	19.2	19.5	19.7	20.0	20.2	20.4	2200
	5000	19.0	18.4	18.7	18.9	19.1	19.4	19.6	19.9	20.1	20.3	2200
	6000	19.0	18.2	18.5	18.7	19.0	19.3	19.5	19.8	20.0	20.1	2200
	7000	19.0	18.1	18.4	18.6	18.9	19.2	19.4	19.6	19.9	20.0	2200
	8000	19.0	17.9	18.1	18.4	18.7	19.0	19.2	19.4	19.7	19.9	2200
	9000	19.0	17.8	18.0	18.3	18.6	16.9	19.1	19.3	19.6	19.8	2200
	10000	19.0	17.7	17.9	18.2	18.5	18.8	19.0	19.2	19.5		2200
	11000	19.2	17.6	17.8	18.1	18.3	18.6	18.8	19.1	19.4		2200
	12000	19.5	17.4	17.7	18.0	18.2	18.5	18.7	19.0	18.3		2300
	13000	19.8	17.3	17.6	17.8	18.0	17.4	17.7	17.9	18.2		2300
	14000	20.2	17.2	17.5	16.8	17.1	17.3	16.5	16.7	16.9		2450
	15000	20.7	16.3	16.5	16.7	16.0	16.2	16.4	16.6	15.9		2600
	16000	21.2	16.2	15.4	15.6	15.9	15.1	15.3	15.6	15.8		2600
	17000	21.8	15.0	15.3	14.6	14.8	15.0					2600
	18000	22.4	14.0	14.3	14.5							2600

NOTES:

(1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
(2) THE CHART ALLOWS FOR AN AVERAGE CARBURETOR AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
(3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

PROCEDURE:

READ FUEL FLOW AND MANIFOLD PRESSURE DIRECTLY OPPOSITE ALTITUDE. READ ENGINE RPM WITHIN BRACKETED AREAS.

Figure A1-2-5

POWER SCHEDULE–100 BHP

MIXTURE: APPROXIMATE BEST POWER

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

BHP/ Eng.	Press. Alt. (Ft.)	Fuel Flow (Gal/Hr) 2 Eng.	Manifold Pressure (In. Hg.)									RPM
			Outside Air Temperature (°C)									
			-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	
100	S. L.	16.9	17.9	18.1	18.3	18.5	18.7	18.9	19.1	19.4	19.6	2100
	1000	16.9	17.7	17.9	18.1	18.3	18.5	18.8	19.0	19.2	19.4	2100
	2000	16.9	17.6	17.8	18.0	18.2	18.4	18.6	18.8	19.0	19.2	2100
	3000	16.9	17.4	17.6	17.8	18.0	18.2	18.4	18.6	18.8	19.0	2100
	4000	16.9	17.2	17.4	17.6	17.9	18.1	18.3	18.5	18.7	18.9	2100
	5000	16.9	17.1	17.3	17.5	17.8	18.0	18.2	18.4	18.6	18.8	2100
	6000	16.9	16.9	17.1	17.4	17.6	17.8	18.0	18.2	18.4	18.6	2100
	7000	16.9	16.7	16.9	17.2	17.4	17.6	17.8	18.0	18.2	18.4	2100
	8000	16.9	16.6	16.8	17.0	17.2	17.5	17.7	17.9	18.1	18.3	2100
	9000	16.9	16.5	16.7	16.9	17.1	17.3	17.5	17.8	17.9	18.1	2100
	10000	16.9	16.3	16.6	16.8	17.0	17.2	17.4	17.6	17.8		2100
	11000	17.0	16.2	16.4	16.6	16.9	17.1	17.3	17.5	17.7		2100
	12000	17.1	16.1	16.3	16.5	16.7	16.9	17.1	17.3	17.5		2100
	13000	17.4	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4		2100
	14000	17.7	15.9	16.1	16.3	16.5	16.7	16.9	17.1	17.3		2100
	15000	18.0	15.8	16.0	16.2	16.4	16.6	16.8	17.0	15.5		2300
	16000	18.4	15.6	15.9	16.1	16.3	14.9	15.0	15.2			2300
	17000	18.9	15.5	14.2	14.4	14.6	14.8	14.9	15.1			2300
	18000	19.4	13.9	14.1	14.3	14.5	14.7	14.8	14.1			2450
	19000	19.9	13.8	14.0	14.2	13.5	13.7	13.9	14.0			2450
	20000	20.4	12.9	13.1	13.3	13.4	13.6					2450

NOTES:

1. (1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
2. (2) THE CHART ALLOWS FOR AN AVERAGE CARBURETOR AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
3. (3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

PROCEDURE:

READ FUEL FLOW AND MANIFOLD PRESSURE DIRECTLY OPPOSITE ALTITUDE. READ ENGINE RPM WITHIN BRACKETED AREAS.

Figure A1-2-6

POWER SCHEDULE–80 BHP

MIXTURE: APPROXIMATE BEST POWER

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

BHP Eng.	Press. Alt. (Ft.)	Fuel Flow (Gal/Hr) 2 Eng.	Manifold Pressure (In.Hg.) Outside Air Temperature (°C) -40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	RPM
80	S.L.	15.1	15.6	15.8	15.9	16.0	16.2	16.4	16.6	16.8	16.9	2100
	1000	15.1	15.4	15.6	15.7	15.9	16.1	16.3	16.5	16.7	16.8	2100
	2000	15.1	15.3	15.4	15.6	15.8	16.0	16.1	16.3	16.5	16.7	2100
	3000	15.1	15.0	15.2	15.4	15.6	15.8	16.0	16.2	16.3	16.5	2100
	4000	15.1	14.9	15.0	15.2	15.4	15.6	15.8	16.0	16.1	16.3	2100
	5000	15.1	14.8	14.9	15.1	15.3	15.5	15.7	15.9	16.0	16.2	2100
	6000	15.1	14.7	14.8	15.0	15.1	15.3	15.5	15.7	15.9	16.0	2100
	7000	15.1	14.5	14.7	14.9	15.0	15.2	15.4	15.6	15.8	15.9	2100
	8000	15.1	14.4	14.6	14.7	14.9	15.0	15.2	15.4	15.6	15.7	2100
	9000	15.1	14.3	14.5	14.6	14.8	14.9	15.1	15.3	15.5	15.6	2100
	10000	15.1	14.2	14.4	14.5	14.6	14.8	14.9	15.1	15.3	15.5	2100
	11000	15.1	14.0	14.2	14.4	14.5	14.7	14.8	15.0	15.2		2100
	12000	15.2	13.8	14.0	14.2	14.4	14.5	14.7	14.9	15.0		2100
	13000	15.4	13.7	13.9	14.1	14.3	14.4	14.6	14.8	14.9		2100
	14000	15.7	13.6	13.8	14.0	14.2	14.3	14.5	14.7	14.8		2100
	15000	15.9	13.5	13.7	13.9	14.1	14.2	14.4	14.6	14.7		2100
	16000	16.2	13.4	13.6	13.8	14.0	14.1	14.3	14.5			2100
	17000	16.6	13.2	13.4	13.6	13.8	14.0	14.2	14.4			2100
	18000	16.9	13.1	13.3	13.5	13.7	13.9	14.0	14.2			2100
	19000	17.3	13.0	13.2	13.4	13.6	13.8	13.9	14.1			2100
	20000	17.7	12.9	13.1	13.3	13.5	13.7	13.8				2100

NOTES:

(1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
(2) THE CHART ALLOWS FOR AN AVERAGE CARBURETOR AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
(3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

Figure A1-2-7

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INTRODUCTION.

Part 3 contains the takeoff performance that may be expected for both normal and emergency conditions. The charts are constructed so that variables normally encountered may be accounted for. The variations in engine performance with temperature and pressure deviations from standard is included in the charts and need not be accounted for separately.

DISCUSSION OF CHARTS.

In the succeeding paragraphs, each chart is discussed in detail and a solution to a sample problem is shown. The following example problem should be used throughout part 3.

EXAMPLE:

Known:

1. **Temperature = 25°C.**
2. **Field Pressure Altitude = 2000 ft.**
3. **Takeoff Runway = 010°**
4. **Wind Direction = 075°**
5. **Wind Velocity = 24 knots**
6. **Gross Weight = 4830 lbs.**
7. **Runway Length = 5000 ft.**
8. **Runway Condition = Wet Concrete**

TAKEOFF AND LANDING CROSSWIND CHART.

The takeoff and landing crosswind chart figure A1-3-1, is used to resolve the prevailing wind into headwind and crosswind components. The crosswind component is used to determine the minimum speed of which the nose wheel may be lifted off during takeoff or touched down during landing. The headwind (or tailwind) component is used to determine takeoff and landing distances in the following paragraphs.

EXAMPLE: (See figure A1-3-1).

Known:

1. **Wind Direction = 075°**
2. **Wind Velocity = 24 knots**

Find:

1. **Wind Direction from Runway = 075° −010° =065°**
2. **Crosswind Component = 22 knots.**
3. **Headwind Component = 10 knots**
4. **Move vertically to base line and right to minimum nose wheel lift off and touch down speed = 92 mph IAS**

NORMAL TAKEOFF GROUND RUN.

The normal takeoff ground run chart (figure A1-3-2) is used to determine the runway length required to accelerate to 95 mph IAS and lift off. The normal takeoff airspeed is 95 mph IAS and is recommended at all times unless prohibited by runway length, strong crosswind, etc. This speed allows a safe margin above minimum single engine control speed and a reasonable single engine rate-of-climb should an engine fail during takeoff.

EXAMPLE: (See figure A1-3-2)

Known:

1. **Temperature = 25°C.**
2. **Field Pressure Altitude = 2000 ft.**
3. **Gross Weight = 4830 lbs.**
4. **Headwind = 10 knots**

Find:

1. **Normal Ground Run = 1370 ft.**

MAXIMUM PERFORMANCE TAKEOFF DISTANCE.

The minimum distance in which the aircraft can clear a 50 foot obstacle is shown in figure A1-3-3. These distances require the use of a maximum performance technique which is more demanding of the pilot and allows less margin of safety than the normal takeoff technique. Takeoff airspeeds are listed on the chart for three gross weights.

EXAMPLE: (See figure A1-3-3)

Note: Although the runway length assumed for the example conditions (5000 feet) is adequate for using the normal takeoff technique, the same conditions are used here to illustrate the use of the chart.

Known:

1. **Temperature = 25°C.**
2. **Field Pressure Altitude = 2000 ft.**
3. **Gross Weight = 4830 lbs.**
4. **Headwind = 10 knots**

Find:

1. **Minimum distance to clear 50 foot obstacle = 1440 ft.**

ACCELERATE AND STOP DISTANCE.

The runway lengths required to accelerate to 95 mph IAS followed by hard braking to a complete stop are shown in figure A1-3-4. The chart is based on using full power to accelerate to 95 mph IAS followed by power reduction to idle and hard braking.

EXAMPLE: (See figure A1-3-4).

Known:

1. **Temperature = 25°C.**
2. **Field Pressure Altitude = 2000 ft.**
3. **Gross Weight = 4830 lbs.**
4. **Headwind = 10 knots**
5. **Runway Conditions = Wet Concrete.**

Find:

1. **Runway length required to accelerate to 95 mph IAS and stop = 3300 ft.**

REFUSAL SPEED.

The refusal speed chart figure A1-3-5, is used to find the maximum speed to which the aircraft can be accelerated and stopped in the available runway length. This chart should be used to find the maximum refusal speed when the available runway length will not permit a refusal speed of 95 mph IAS. (from figure A1-3-4).

EXAMPLE: (See figure A1-3-5).

Known:

1. **Temperature = 25°C.**
2. **Field Pressure Altitude = 2000 ft.**
3. **Gross Weight = 4830 lbs.**
4. **Headwind = 10 knots.**
5. **Runway Conditions = Wet Concrete.**
6. **Runway Length = 3000 ft.**

Find:

1. **Refusal Speed = 91 mph IAS.**

TAKEOFF GROSS WEIGHT LIMIT.

Figure A1-3-6 is used to determine the maximum gross weight to which the aircraft may be loaded in order to maintain a desired rate-of-climb should an engine fail immediately after takeoff. The chart assumes that the propeller on the failed engine is feathered, the gear is retracted, and the normal takeoff speed of 95 mph IAS is maintained.

EXAMPLE: (See figure A1-3-6)

Known:

1. **Temperature = 25°C.**
2. **Pressure Altitude = 2000 ft.**
3. **Desired Rate-of-Climb = 100 feet per minute.**

Find:

1. Maximum Gross Weight for Desired Rate-of-Climb: The maximum gross weight which will allow 100 feet per minute rate-of-climb is in excess of 4830 pounds and will not further restrict the maximum takeoff weight.

TAKEOFF AND LANDING CROSSWIND CHART

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

ENGINES: (2) 0-470-M
FUEL GRADE: 91 96
FUEL DENSITY: 6 LB. GAL

NOTE: ENTER CHART WITH MAXIMUM GUST VELOCITY

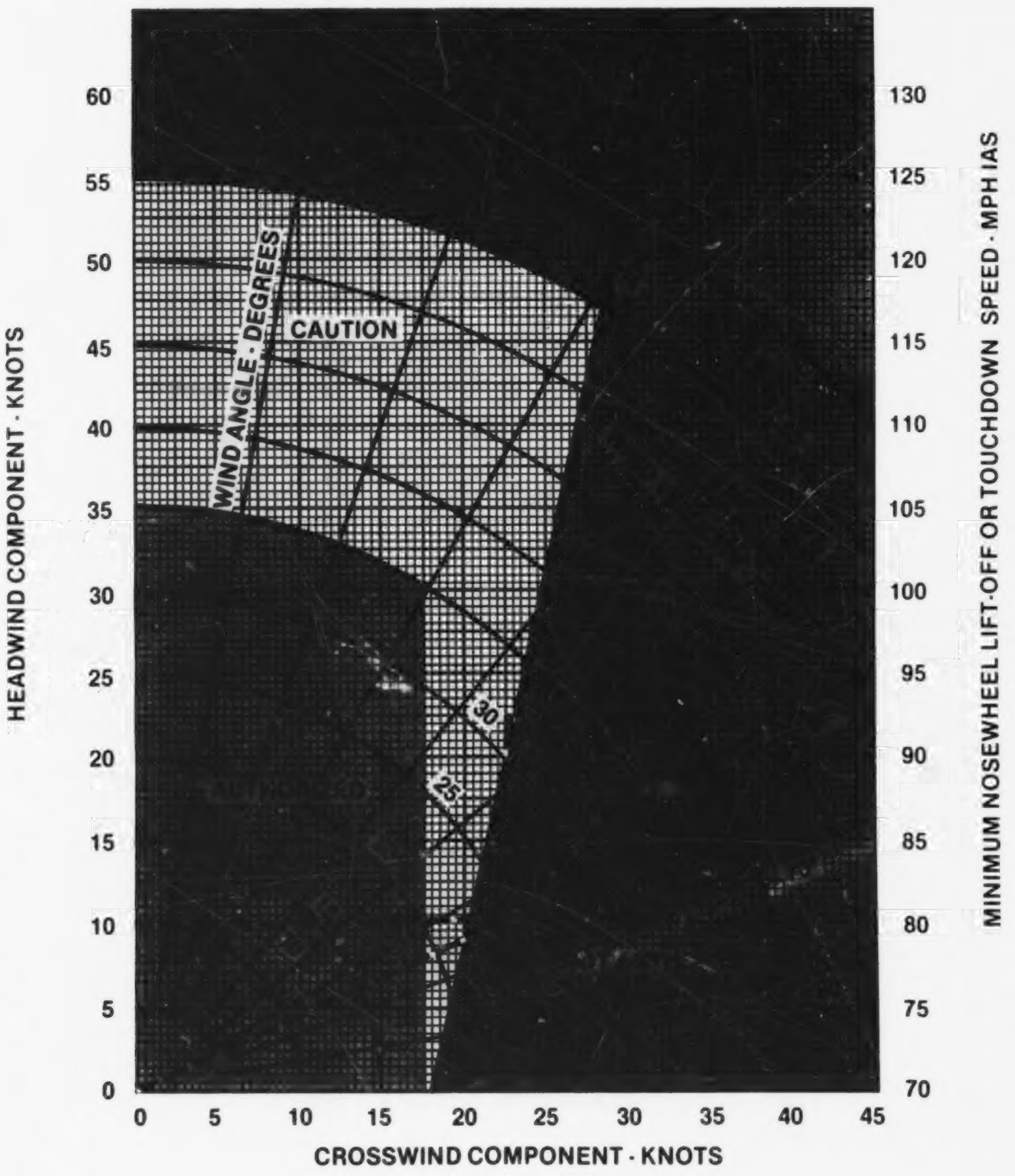
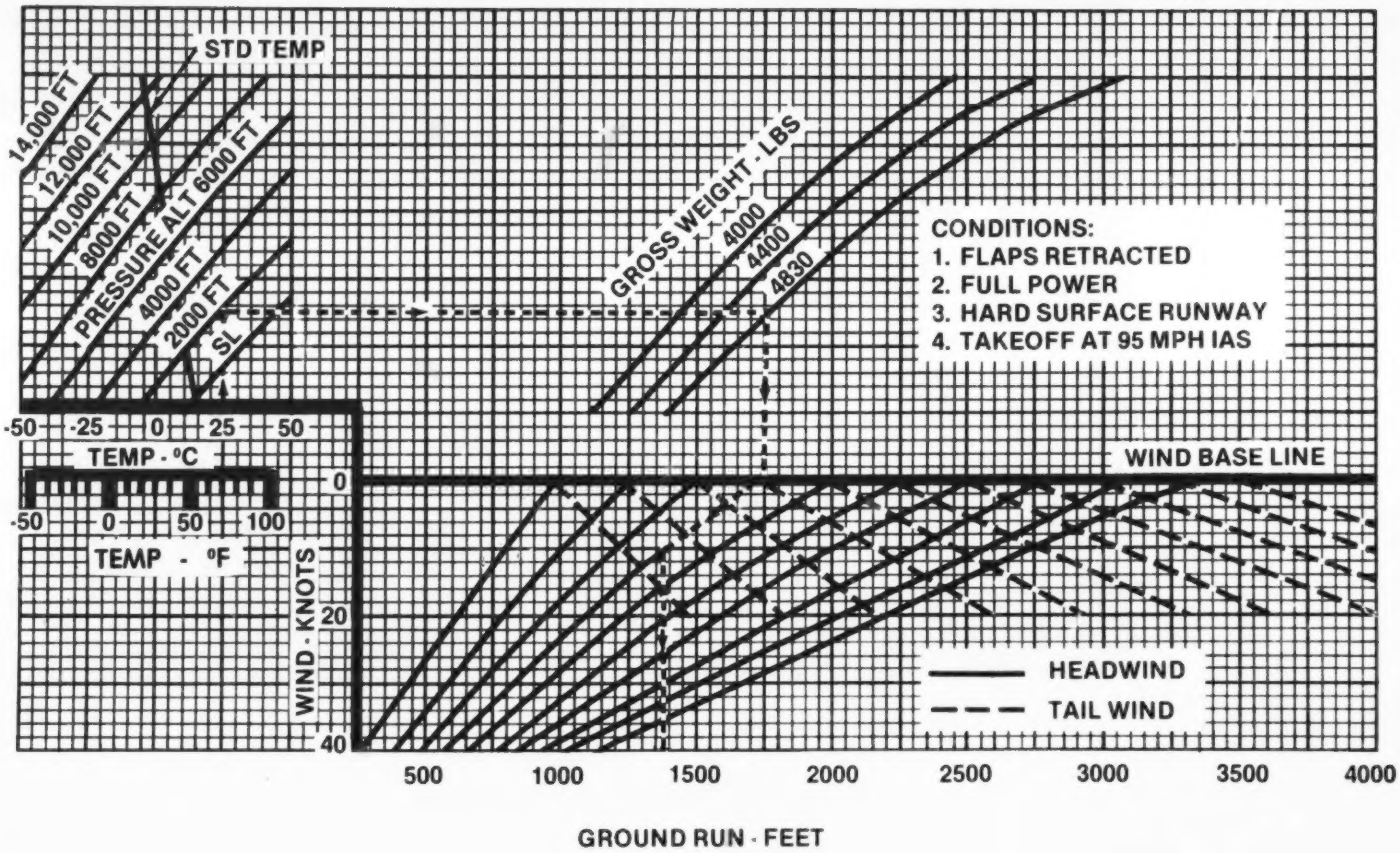


Figure A1-3-1

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

NORMAL TAKEOFF GROUND RUN

ENGINES (2): 0-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.



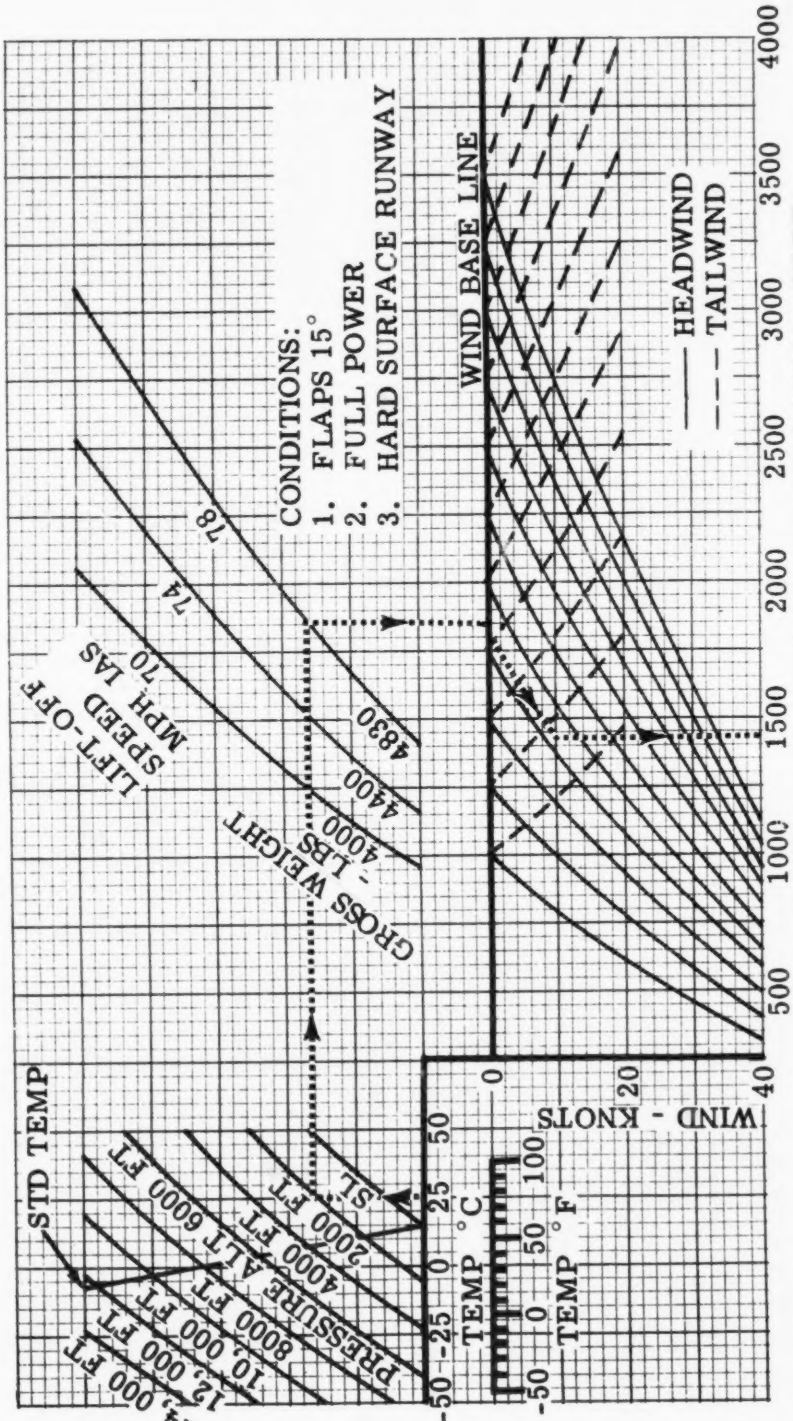
CONDITIONS:
1. FLAPS RETRACTED
2. FULL POWER
3. HARD SURFACE RUNWAY
4. TAKEOFF AT 95 MPH IAS

Figure A1-3-2

MAXIMUM PERFORMANCE TAKEOFF DISTANCE

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.



CONDITIONS:
1. FLAPS 15°
2. FULL POWER
3. HARD SURFACE RUNWAY

Figure A1-3-3

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

ACCELERATE AND STOP DISTANCE

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

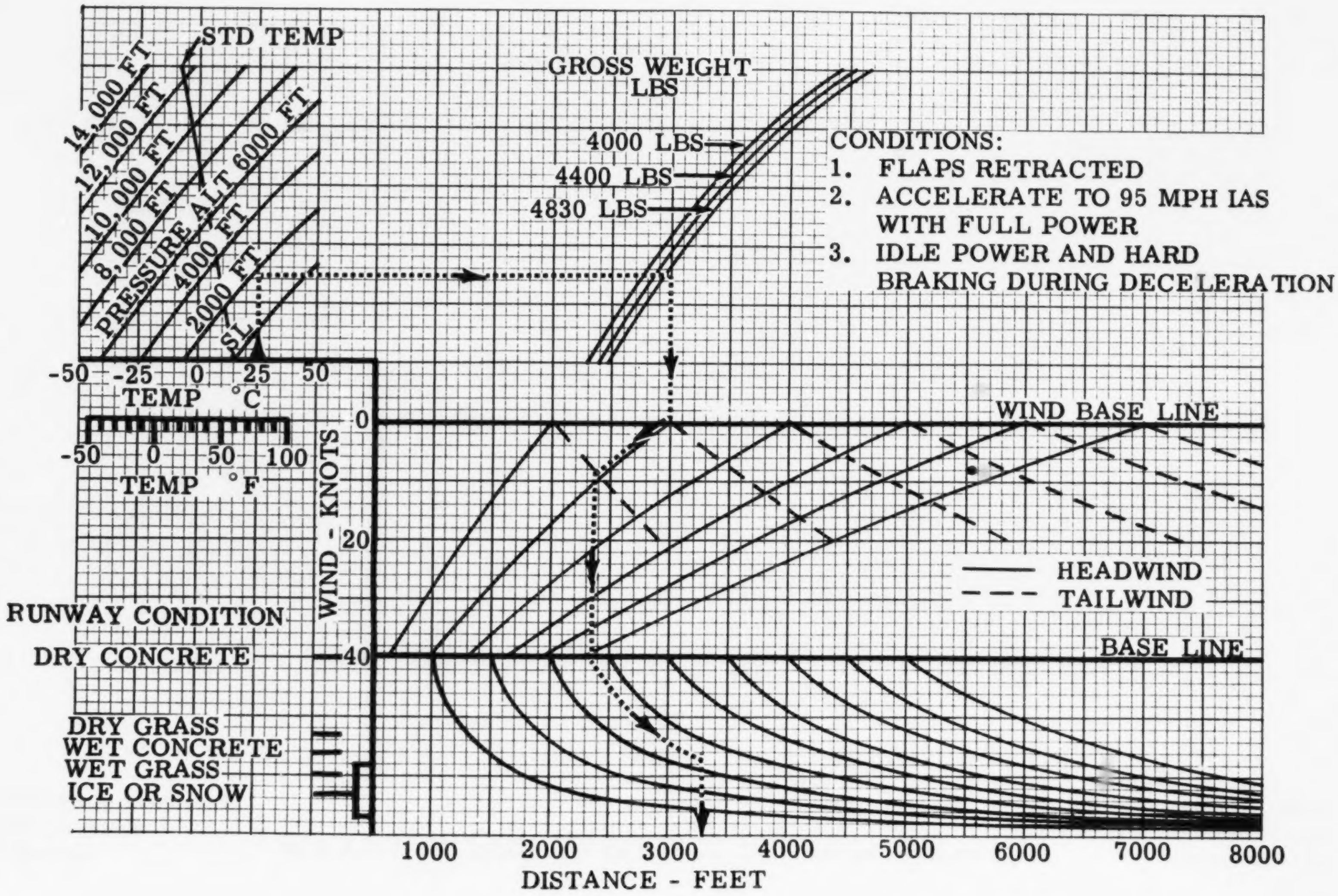


Figure A1-3-4

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

REFUSAL SPEED

ENGINES (2) : O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

CONDITIONS:
1. FLAPS UP OR 15° DURING ACCELERATION
2. FULL POWER DURING ACCELERATION
3. FLAPS UP AND HARD BRAKING DURING DECELERATION

NOTE
Minimum Safe Single-Engine
Airspeed - 95 MPH IAS

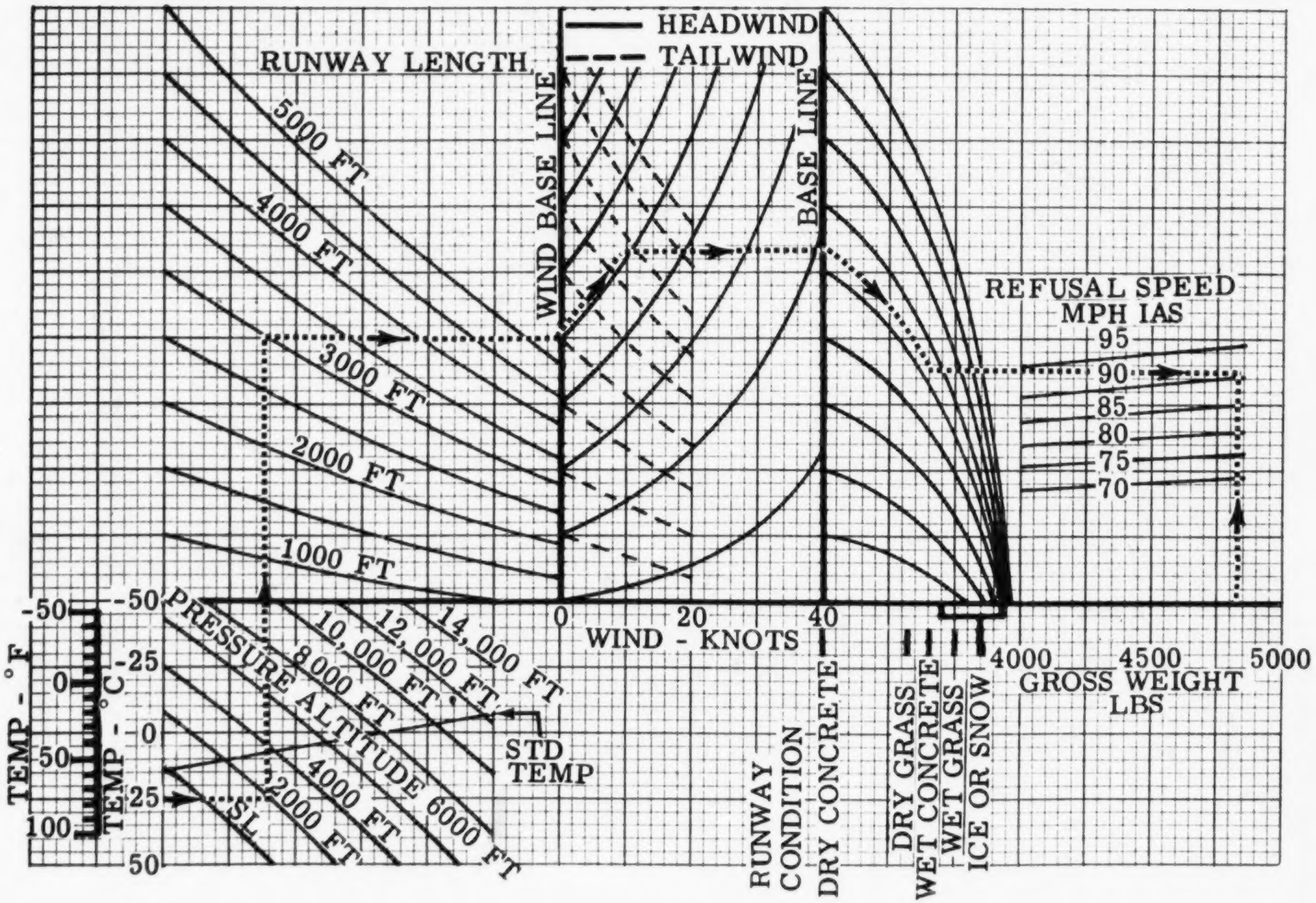


Figure A1-3-5

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

TAKEOFF GROSS WEIGHT LIMIT

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

CONDITIONS:
1. ONE ENGINE OPERATING AT MAXIMUM POWER
2. PROPELLER ON FAILED ENGINE FEATHERED
3. GEAR AND FLAPS RETRACTED
4. 95 MPH IAS

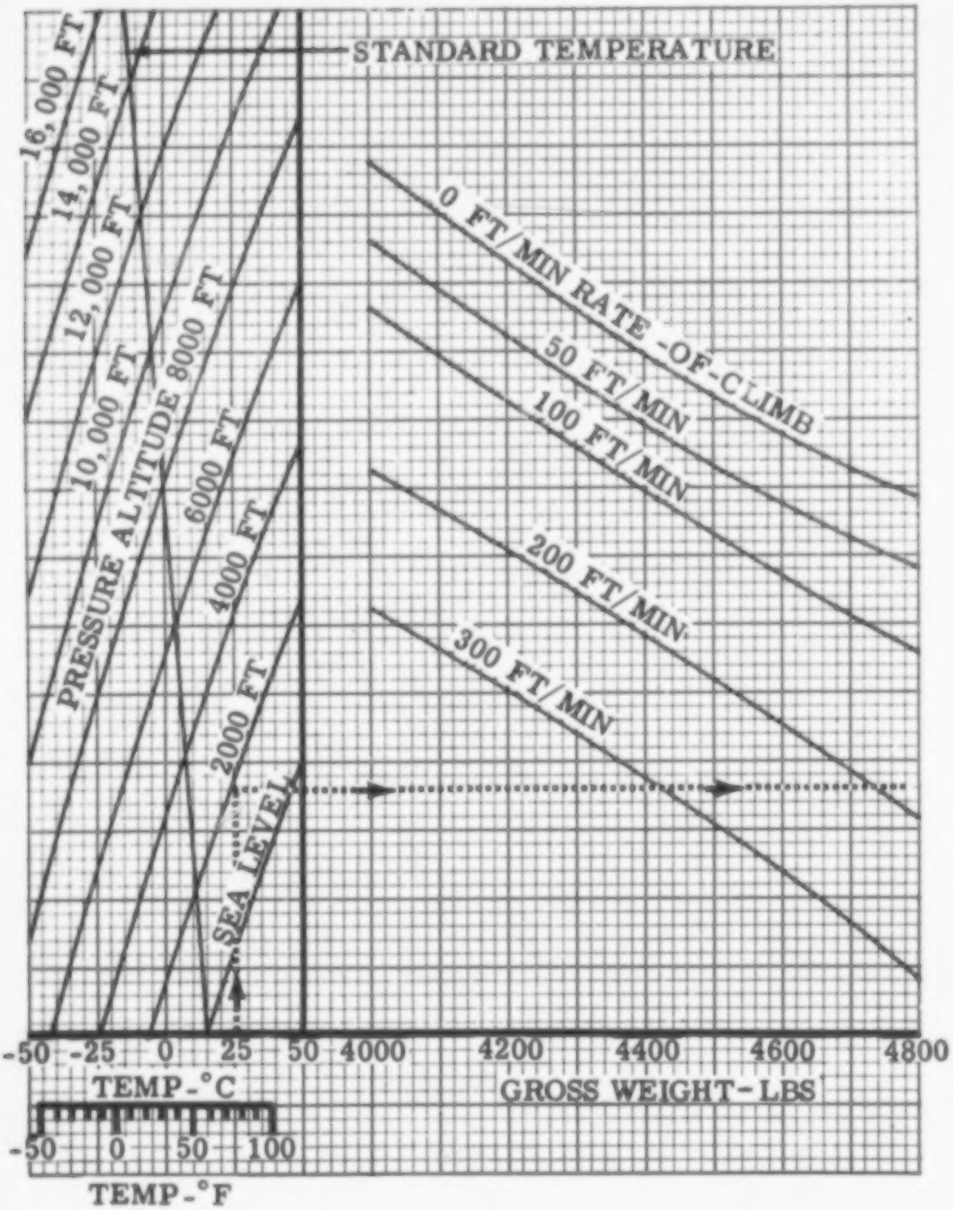


Figure A1-3-6

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INTRODUCTION.

The climb performance presented in this part includes data for normal en route climbs using both maximum power (2600 rpm) and 75% power (2450 rpm). Emergency climb data, with one engine inoperative, is also included.

RATE-OF-CLIMB.

The rate-of-climb with maximum power (2600 rpm and full throttle) is shown on figure A1-4-1 and with 75% power (2450 rpm and 24 inches Hg.) on figure A1-4-3. Both charts are based on density altitude, however, a conversion chart for using pressure altitude and temperature is provided on each chart.

EXAMPLE: (See figure A1-4-1 and A1-4-3)

Known:

1. **Temperature = 10°C.**
2. **Pressure Altitude = 10,000 ft.**
3. **Gross Weight = 4830 lbs.**

Find:

1. **Rate-of-Climb with Maximum Power (figure A1-4-1) =650 ft./min.**
2. **Rate-of-Climb with 75% Power (figure A1-4-3) = 500 ft./min.**

CLIMB PERFORMANCE.

The time elapsed, fuel consumed and distance traveled during an on course climb from sea level density altitude are shown in figures A1-4-2 and A1-4-4 for maximum power and 75% power.

EXAMPLE: (See figure A1-4-2 and A1-4-4).

Known:

1. **Start Climb at Sea Level Density Altitude.**
2. **Climb to 10,000 Feet Pressure Altitude.**
3. **Temperature at 10,000 Feet = 10°C.**
4. **Gross Weight = 4830 lbs.**

Find:

1. **Time Elapsed, Distance Traveled and Fuel Used During Climb.**

Maximum Power Climb (See figure A1-4-2).
Time Elapsed = 11 Minutes.
Distance Traveled = 23 Nautical Miles.
Fuel Consumed = 10.5 Gallons.

75% Power Climb (See figure A1-4-4).
Time Elapsed = 15 Minutes.
Distance Traveled = 34 Nautical Miles.
Fuel Consumed = 12 Gallons.

SINGLE-ENGINE RATE-OF-CLIMB.

The rate-of-climb and recommended climb speeds with one engine inoperative (propeller feathered) and the operating engine at maximum power are shown on figure A1-4-5. Density altitude is used as the primary scale, however, a chart for converting temperature and pressure to density altitude is included.

EXAMPLE: (See figure A1-4-5).

Known:

1. **Pressure Altitude = 6000 ft.**
2. **Temperature = 10°C.**
3. **Gross Weight = 4400 lbs.**

Find:

1. **Rate-of-Climb = 140 ft./min.**
2. **Recommended Climb Speed = 102.5 mph IAS.**

SINGLE-ENGINE DRIFT DOWN.

Should an engine failure occur while operating above the single engine absolute ceiling, the time elapsed and distance traveled while drifting down is determined from figure A1-4-6. The chart is based on flaps up, gear up, propeller on inoperatvie engine feathered and operating engine at full power. Indicated airspeeds for minimum rate-of-descent are included in the chart.

EXAMPLE: (See figure A1-4-6).

Known:

1. **Engine Failure Occurs a 15,000 ft. Density Altitude.**
2. **Gross Weight = 4400 lbs.**

Find:

1. **Distance Traveled During Drift Down to Absolute Ceiling = 163 Nautical Miles.**
2. **Time Elapsed During Drift Down = 92 Minutes.**
3. **Recommended Speed = 96 mph IAS.**

MODEL: U-3A

DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

RATE-OF-CLIMB

MAXIMUM POWER

2600 RPM, FULL THROTTLE

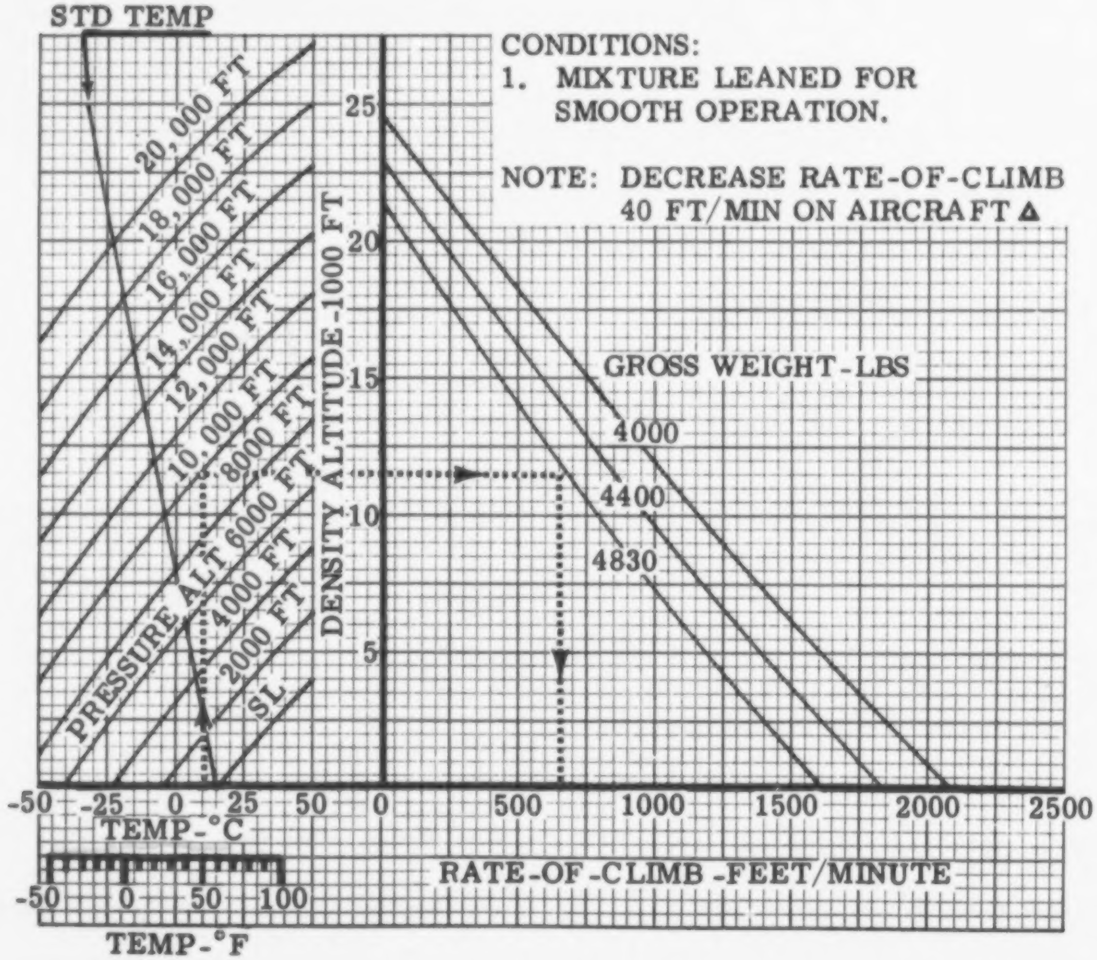
ENGINES (2): O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LBS/GAL.

CLIMB SPEEDS - 4830 LBS.
DECREASE SPEEDS 1 MPH FOR EACH 100 LBS.

ALT.	SL	5000	10,000	15,000	20,000
IAS-MPH	125	122	119	115	111
IAS-KTS	108	106	103	100	96



CONDITIONS:
1. MIXTURE LEANED FOR SMOOTH OPERATION.

NOTE: DECREASE RATE-OF-CLIMB 40 FT/MIN ON AIRCRAFT △

Figure A1-4-1

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

MAXIMUM POWER CLIMB PERFORMANCE

2600 RPM, FULL THROTTLE

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

CONDITIONS:
1. 2600 RPM
2. FULL THROTTLE
3. MIXTURE LEANED FOR SMOOTH OPERATION

NOTE: REFER TO FIGURE A1-4-1 FOR CLIMB SPEEDS

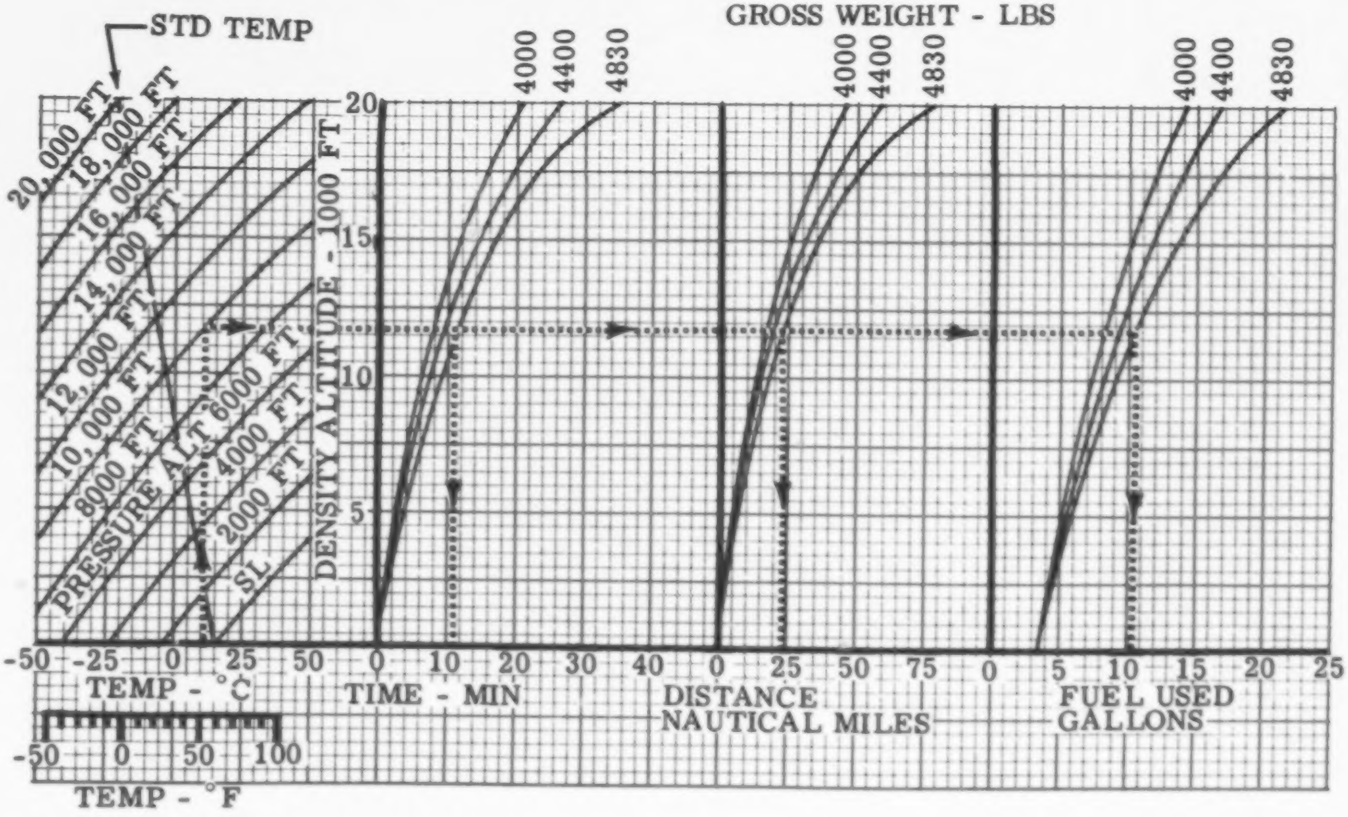


Figure A1-4-2

MODEL: U-3A

DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

RATE-OF-CLIMB

2450 RPM

ENGINES (2): O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LB/GAL

CONDITIONS:

1. 24 INCHES MANIFOLD PRESSURE BELOW 5000 FT AND FULL THROTTLE ABOVE 5000 FT
2. CLIMB SPEED - 130 MPH IAS (113 KTS IAS)
3. MIXTURE LEANED FOR SMOOTH ENGINE OPERATION.

NOTE: DECREASE RATE-OF-CLIMB 40 FT/MIN ON AIRCRAFT ▲

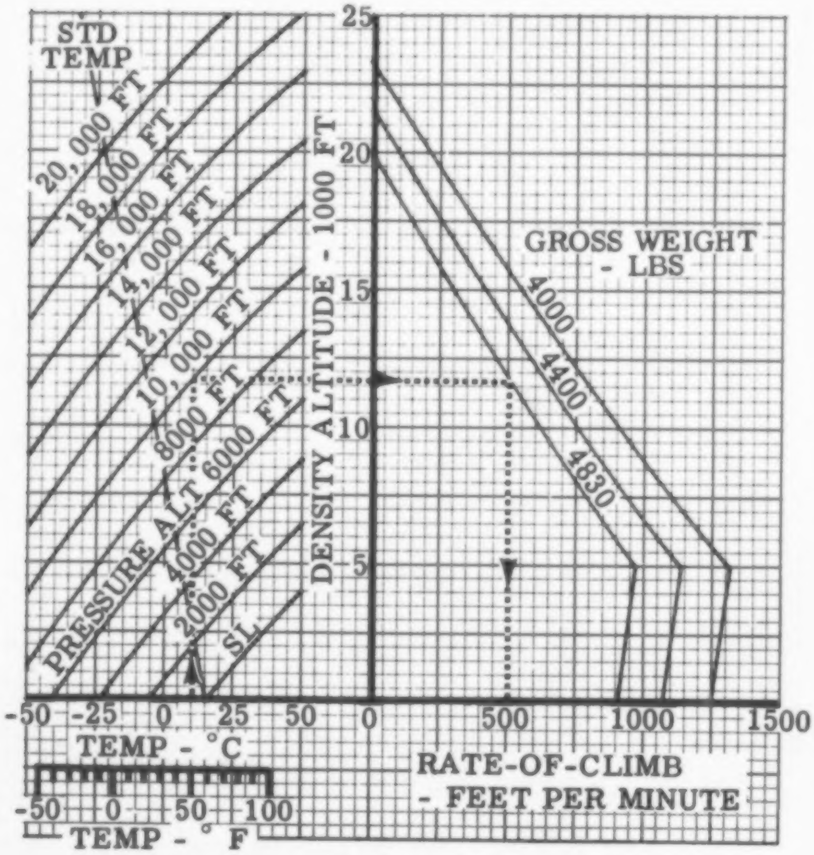


Figure A1-4-3

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

CLIMB PERFORMANCE

2450 RPM

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

CONDITIONS:
1. 24 INCHES MANIFOLD PRESSURE
   FULL THROTTLE ABOVE 5000 FT
2. CLIMB SPEED 130 MPH IAS
3. MIXTURE LEANED FOR SMOOTH OPERATION

NOTE: INCREASE TIME, DISTANCE AND FUEL 10% ON AIRCRAFT △

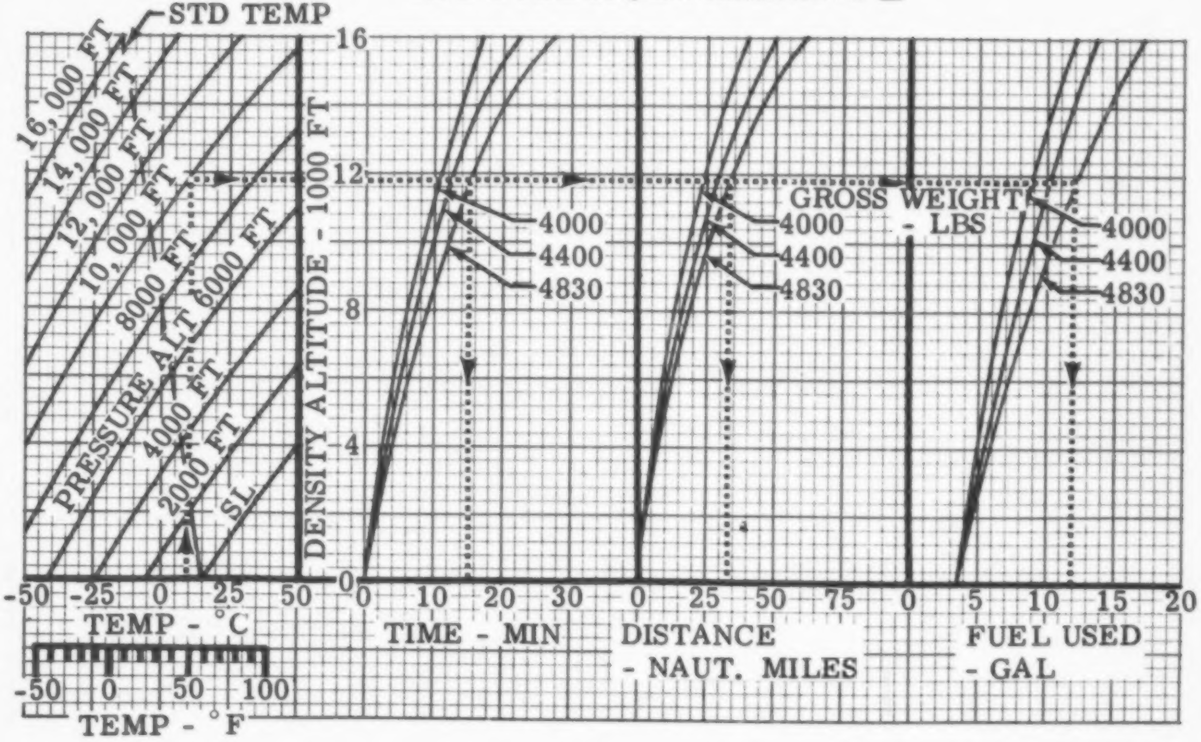


Figure A1-4-4

MODEL: U-3A

DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

SINGLE-ENGINE CLIMB
MAXIMUM POWER

ENGINES (2) : O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LBS/GAL.

CONDITIONS:
1. 2600 RPM AND FULL THROTTLE
2. PROPELLER ON INOPERATIVE ENGINE FEATHERED
3. FLAPS AND GEAR UP

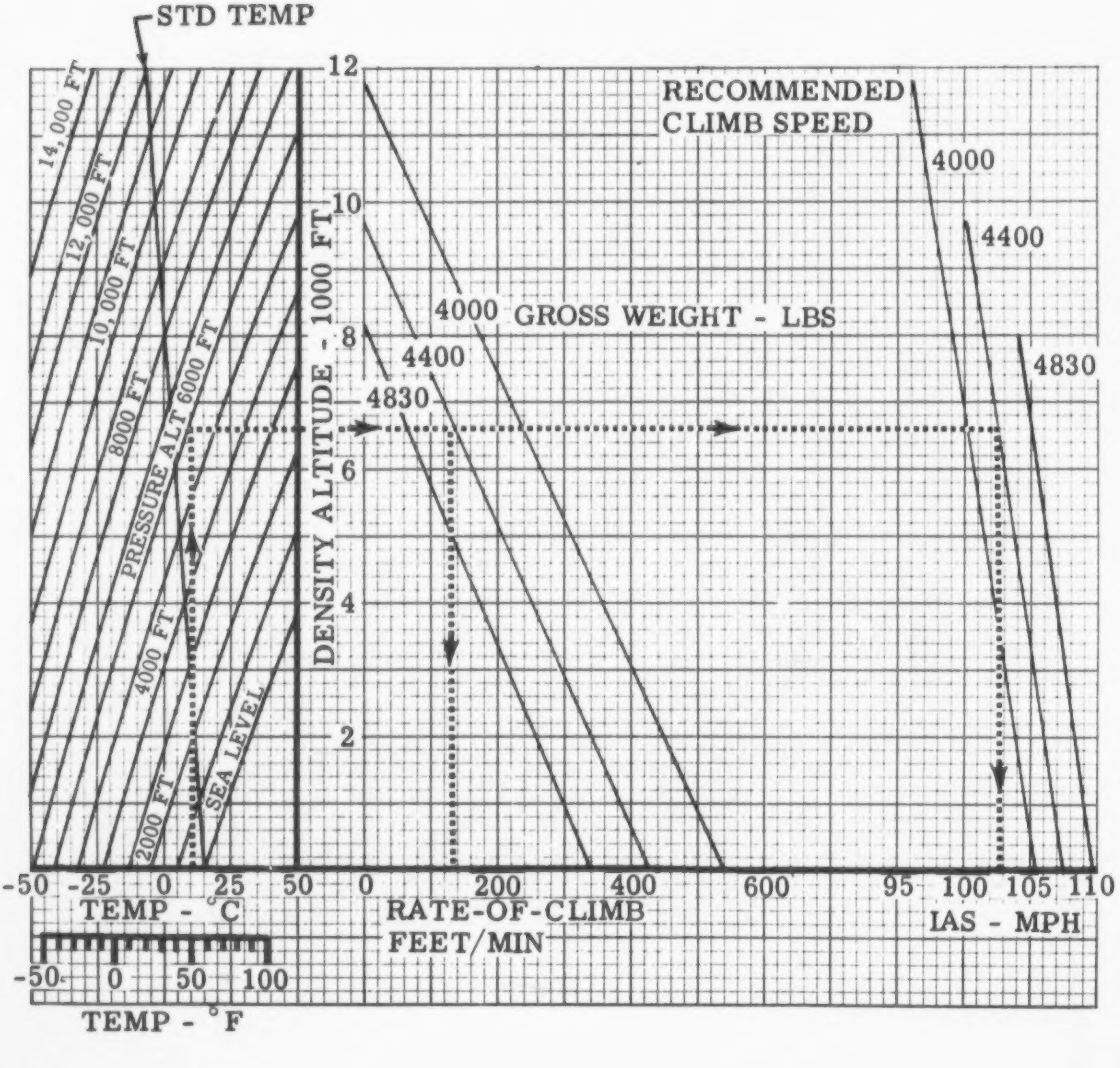


Figure A1-4-5

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

SINGLE-ENGINE DRIFT DOWN TO ABSOLUTE CEILING
(ZERO FOOT PER MINUTE)

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

CONDITIONS:
1. PROPELLER ON INOPERATIVE ENGINE FEATHERED.
2. MAXIMUM POWER.
3. FLAPS AND GEAR UP.

NOTE: DECREASE TIME AND DISTANCE BY 10% ON AIRCRAFT ▲

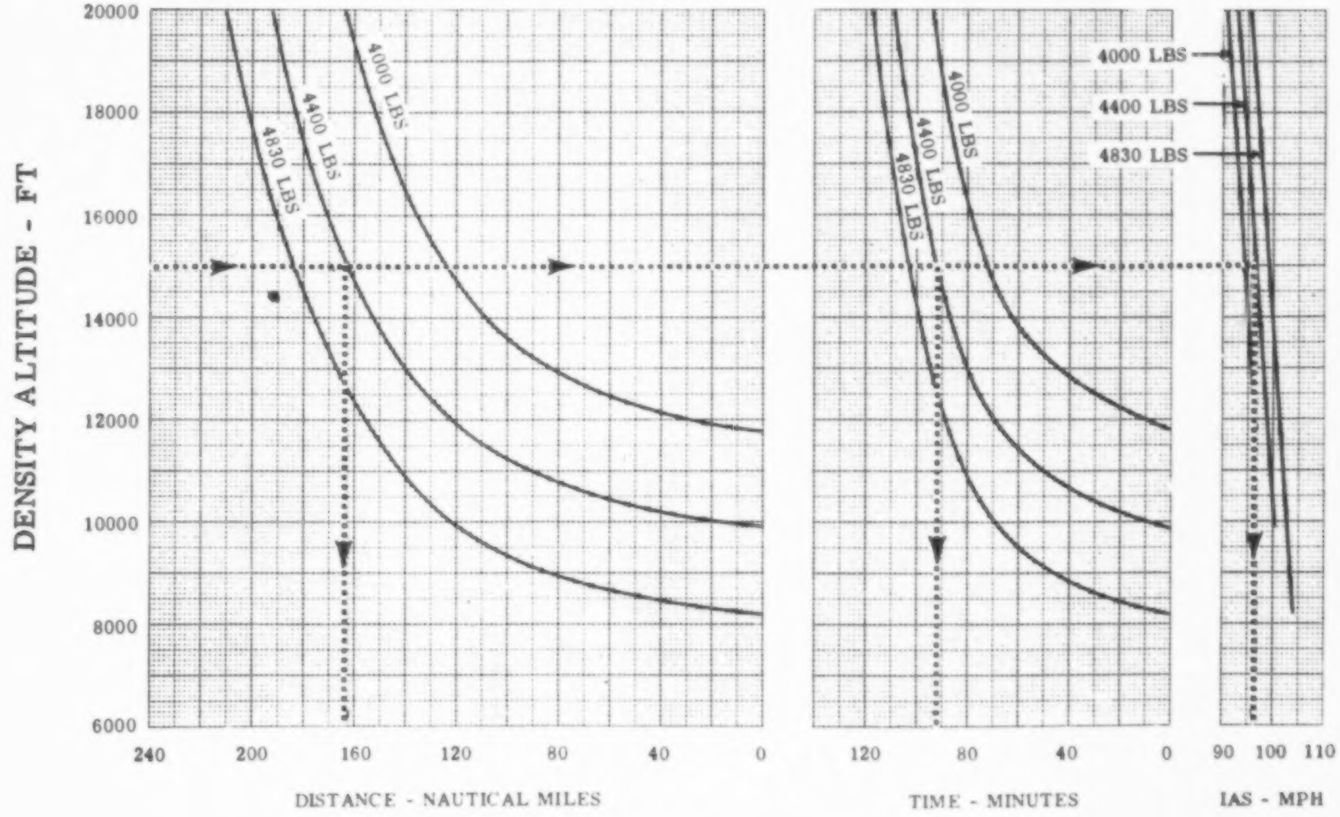


Figure A1-4-6

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INTRODUCTION.

The range of the aircraft may be determined for any conditions up to maximum cruising speed from the data presented in this part. The charts are based on density altitude and no further corrections are necessary to the chart values.

LEVEL FLIGHT PERFORMANCE CHART.

The level flight performance chart (figure A1-5-1) is used to determine the power required to cruise at a given speed and density altitude. Included in the chart are power required values for single engine operation.

EXAMPLE: (See figure A1-5-1).

Known:

1. **Cruise Density Altitude = 10,000 ft.**
2. **Cruise Speed = 140 knots TAS.**
3. **Gross Weight = 4830 lbs.**

Find:

1. **Brake Horsepower Required Per Engine (2 Engine Operation) = 98 BHP Per Engine.**
2. **Indicated Air Speed = 138 mph.**
3. **True Air Speed = 163 mph.**

CRUISE FUEL CONSUMPTION.

The fuel consumption during cruising flight is shown in figure A1-5-2. These values are valid only when the mixture is leaned by the technique described in section VII.

EXAMPLE: (See figure A1-5-2).

For the conditions assumed in the level flight performance example:

Known:

1. **Density Altitude = 10,000 ft.**
2. **Brake Horsepower = 98 BHP Per Engine.**

Find:

1. **Fuel Consumption = 8.38 gallons per hour per engine or: 8.38 x 2 = 16.76 gallons per hour for both engines.**

MODEL: U-3A
DATE: 1 MARCH 1959
DATA BASES: FLIGHT TEST

LEVEL FLIGHT PERFORMANCE

ENGINES (2) : O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

NOTE: INCREASE BHP 4% ON AIRCRAFT △

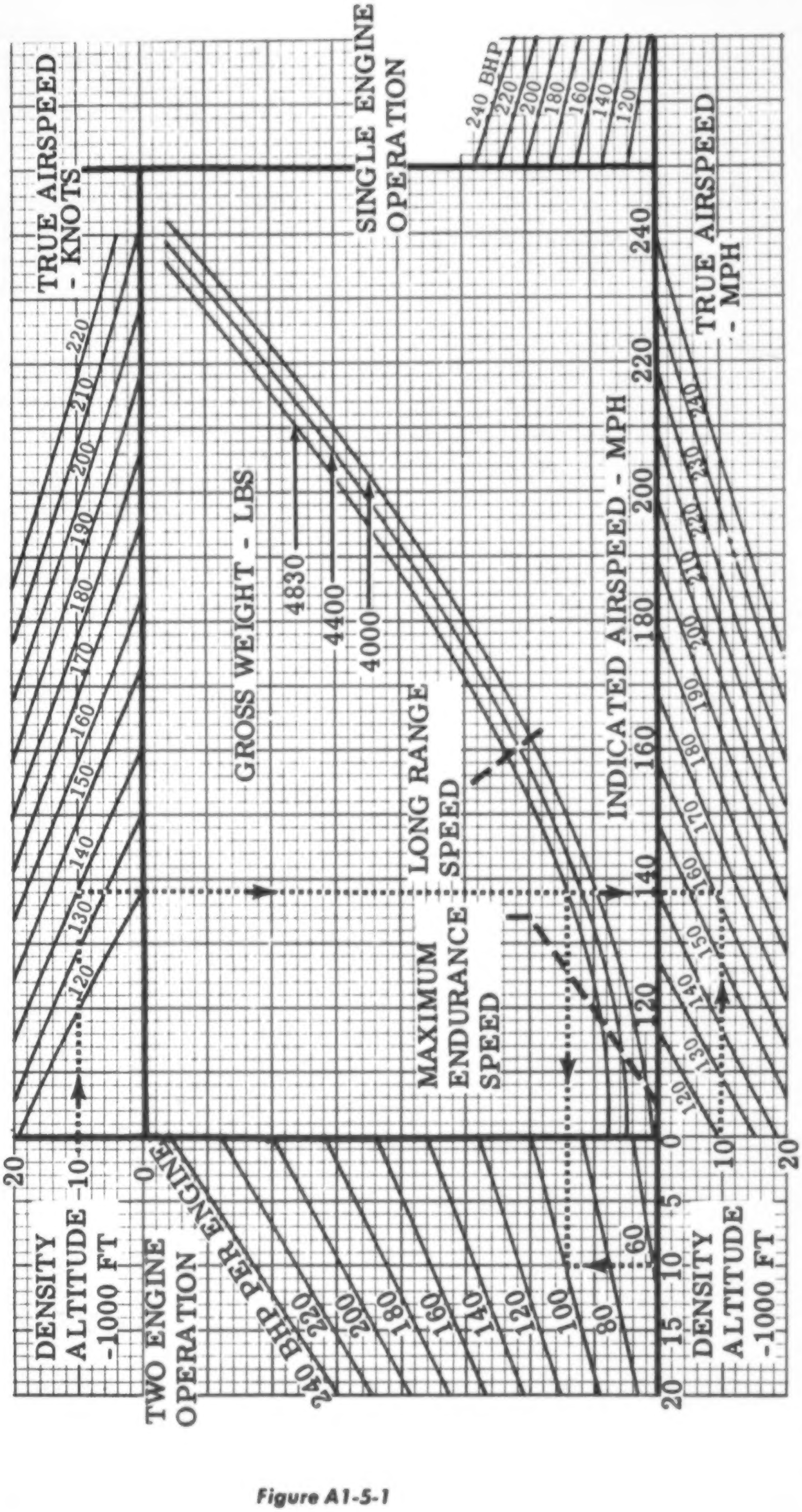


Figure A1-5-1

MODEL: U-3A.

DATE: 1 MARCH 1959

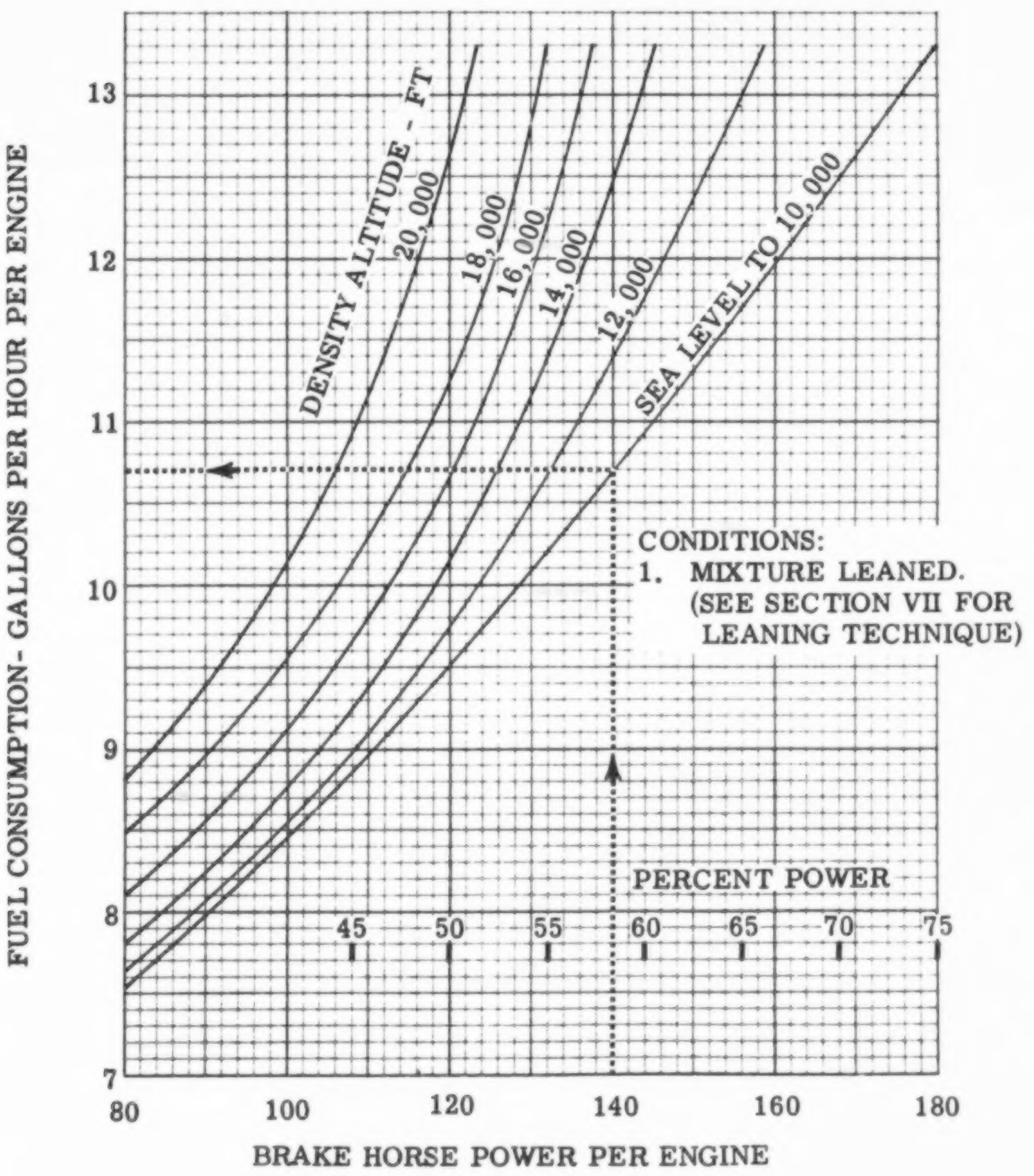
DATA BASES: FLIGHT TEST

CRUISE FUEL CONSUMPTION

ENGINES (2): O-470-M

FUEL GRADE: 91/96

FUEL DENSITY: 6 LBS/GAL.



CONDITIONS:
1. MIXTURE LEANED. (SEE SECTION VII FOR LEANING TECHNIQUE)

Figure A1-5-2

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INTRODUCTION.

The landing performance shown in this part is based on an approach speed of 130% of the stall speed with full (45°) flaps and idle power. To obtain the distance shown, the flaps must be retracted immediately after touchdown and very hard braking applied.

LANDING DISTANCE.

The landing distance chart (figure A1-6-1) is used to find the minimum air distance and ground roll required to stop after landing. The chart includes variable scales for atmospheric conditions, gross weight and runway condition.

EXAMPLE: (See figure A1-6-1)

Known:

1. **Temperature = 25°C.**
2. **Pressure Altitude = 2000 ft.**
3. **Landing Gross Weight = 4200 lbs.**
4. **Wind = 10 Knots Headwind.**
5. **Runway Condition = Wet Concrete.**

Find:

1. **Ground Roll from Touch Down to Stop = 1550 ft.**
2. **Total Distance from 50 ft. Obstacle to Stop = 2750 ft.**

MODEL: U-3A

LANDING DISTANCE

ENGINES (2): O-470-M
FUEL GRADE: 91/96
FUEL DENSITY: 6 LBS/GAL.

DATE: 1 MARCH 1959

DATA BASES: FLIGHT TEST

INDICATED AIRSPEED - MPH

WT	3800	4200	4600	4830
APPROACH	83	88	92	94
STALL	60	62	65	67
TOUCHDOWN SPEED	65	68	71	73

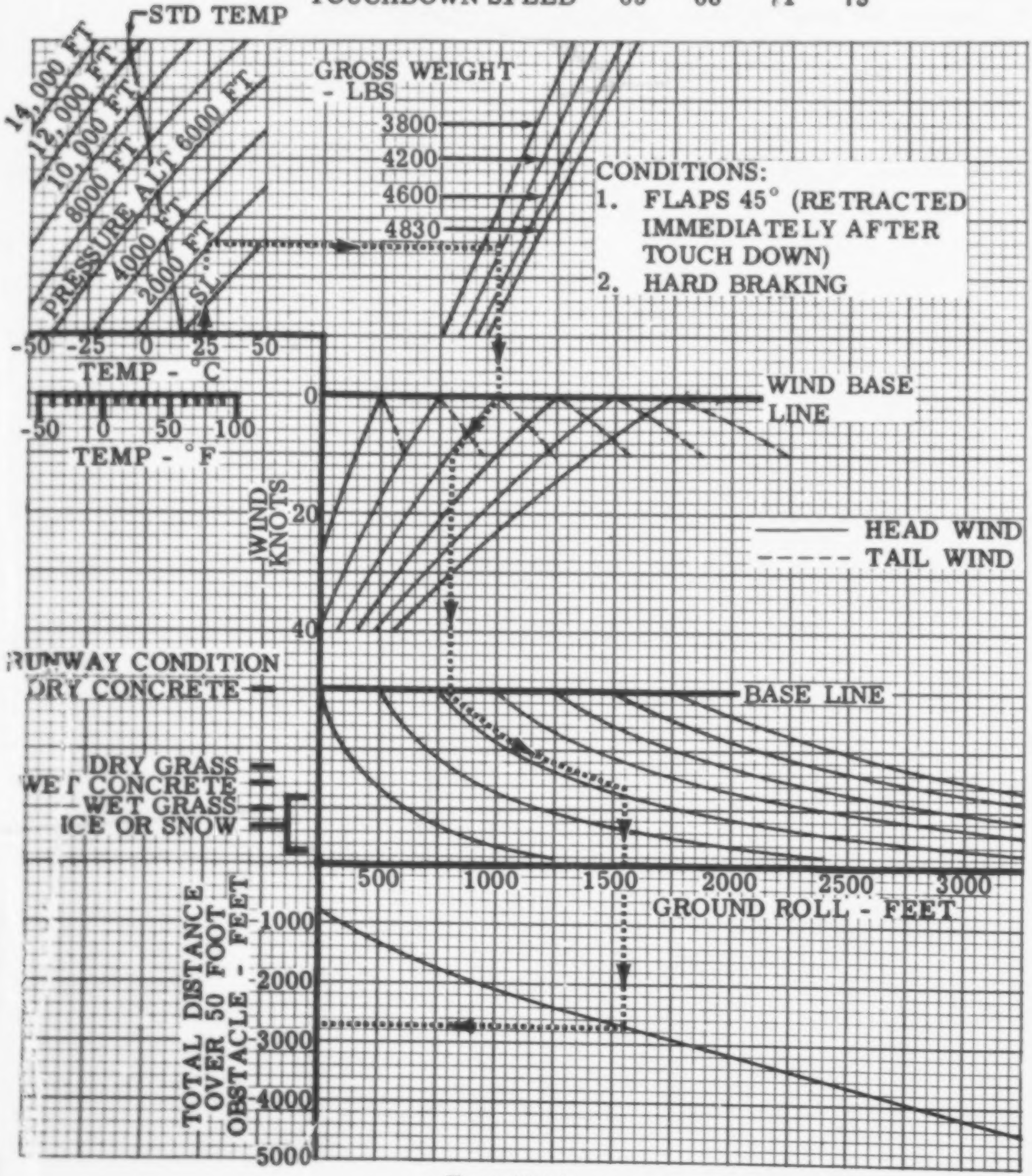

Figure A1-6-1

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Climb....A1-7-1
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Landing Data Card....A1-7-2

INTRODUCTION.

This part is included to illustrate full use of the data in Appendix I. In the following paragraphs an entire mission will be planned and data from each part will be used.

SAMPLE MISSION.

A normal cross country flight is to be flown to a field 600 nautical miles distant. The aircraft is serviced with 130 gallons of gasoline and is loaded to the maximum gross weight (4830 lbs). The conditions prevailing for takeoff include:

1. **Temperature = 20°C.**
2. **Field Pressure Altitude = 1500 ft.**
3. **Field Elevation = 1200 ft.**
4. **Wind = North at 20 knots.**
5. **Runway 01 which is dry concrete and is 5000 feet long, is active.**

EFFECTS OF RUNWAY SURFACE CONDITION (RSC) AND RUNWAY CONDITION READING (RCR) UPON TAKEOFF AND LANDING PERFORMANCE.

When other than dry conditions exist on active runways, base operation officers are responsible for determining and relaying to the base weather station the type of runway covering and the relative slickness of the runway, as determined by the James brake decelerometer. This information will be transmitted as part of the teletype weather sequence. The relative slickness of the runway is determined as outlined in T. O. 33-1-23. This number will either be a one or two digit number and is referred to as the runway condition reading. This number will be followed by the letter "P" if the runway is patchy. A report of SLR14P would indicate slush on the runway, RCR of 14, and patchy conditions. Explanation of terms is as follows:

RCR — Runway condition reading
P — Patchy
WR -- Wet runway
SLR — Slush on runway
LSR — Loose snow on runway
PSR — Packed snow on runway
IR — Ice on runway

a. Using the latest reported RCR, determine the stopping distance factor.
b. Multiply the dry runway ground roll by the stopping distance factor to determine the ground roll on the slippery runway.

Note

If no RCR is available, use 12 for wet runways and 5 for icy runways.

c. The stopping capability curve (figure A1-7-1) is also included in T. O. 1U-3A-1CL-1. "Pilots' Abbreviated Flight Crew Checklist."

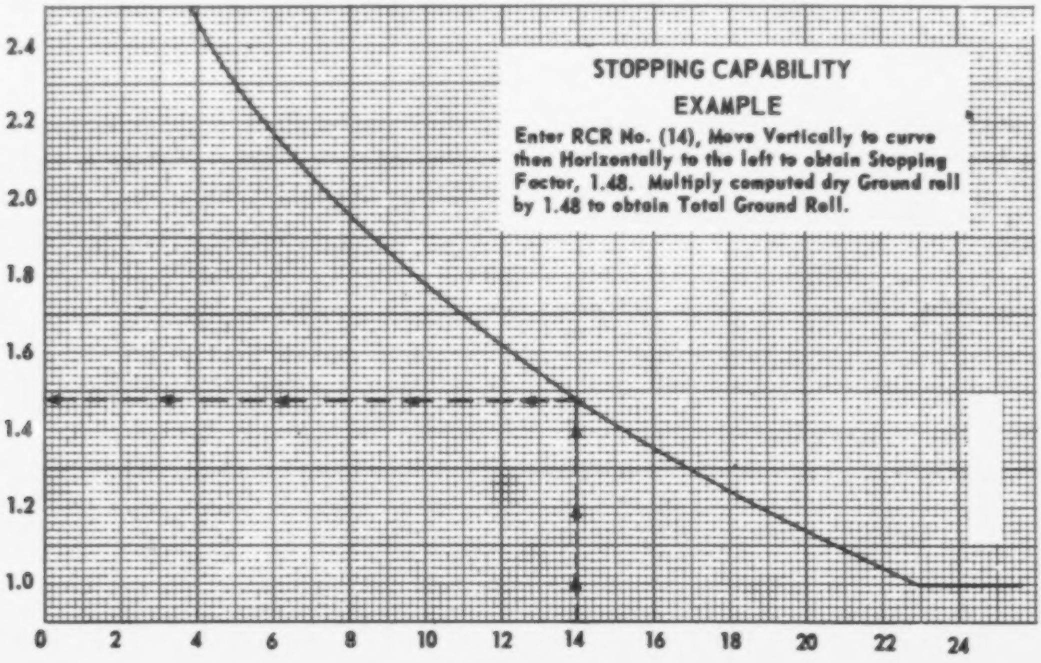

Figure A1-7-1

TAKEOFF AND LANDING DATA CARD.

If the density altitude or runway length dictates, the first step is to fillout the takeoff and landing data card contained in the pilots abbreviated flight crew check list (T.O. 1U-3A-1CL-1). This card contains the conditions prevailing for takeoff and, should an emergency occur, landing immediately after takeoff. Each step in filling out the card is explained in the following paragraphs:

CONDITIONS.

The conditions assumed at the beginning of Part 7 will be used.

Before the normal takeoff distance can be determined, it is necessary to resolve the prevailing wind into headwind and crosswind components.

1. Wind direction from runway = 000 − 10 = 10 degrees.
2. Wind velocity = 20 knots.
3. Headwind component = 19.5 knots — Figure A1-3-1.
4. Crosswind component = 3.5 knots — Figure A1-3-1.
5. Minimum nose wheel lift-off speed = 70 knots IAS — Figure A1-3-1.

Normal Takeoff.

1. Ground run = 1030 feet — Figure A1-3-2.
2. Critical field length = 1620 feet – Figure A1-3-4. Critical field length, as used in this manual, is the distance required to accelerate to 95 mph IAS and stop.
3. Refusal speed = 95 mph IAS.
4. Single-engine rate-of-climb = 235 feet/minute — Figure A1-4-5.
5. Single Engine Service Ceiling (100 feet/minute rate-of-climb) = 5750 feet — Figure A1-4-5

Immediate Landing.

Note

> It is assumed for this problem that a landing immediately after takeoff would be made on the takeoff runway therefore the conditions prevailing for takeoff are used for immediate landing.

1. Landing flaps = 45° down.
2. Threshold speed = 94 mph IAS — Figure A1-6-1.
3. Landing distance = 650 feet — Figure A1-6-1.

U-3A and U-3B
TAKEOFF
DATA CARD

CONDITIONS

Gross Weight 4830 **Lbs.** **Temperature-OAT** 68° **F.** 20° **C.**

Runway Length 5000 **Ft.** **Pressure Altitude** 1500 **Ft.**

Wind Direction North **Velocity** 23 **MPH**

NORMAL TAKEOFF

Ground Run 1030 **Ft.** **Single-Engine Rate-of-**

Critical Field Length 1620 **Ft.** **Climb** 235 **Ft / Min.**

Refusal Speed 95 **MPH IAS** **Single-Engine Ceiling** 5750 **Ft.**

IMMEDIATE LANDING

Landing Flaps 45° **Down**

Threshold Speed 1.3 Stall Speed________94 MPH IAS

Landing Distance 650 **Ft.**

CLIMB.

The sample mission includes an on course climb to 10,000 feet pressure altitude. The en route weather forecast includes a temperature at 10,000 feet of 0°C. over the intended route. The power setting during the climb is to be 2450 rpm and 24 inches Hg. (Full throttle above

5000 feet). The time elapsed, air distance traveled and fuel consumed during the climb are determined as follows:

The time, distance and fuel to climb from sea level density altitude to 10,000 feet pressure altitude at 0°C (10,300 feet density altitude) are: (See figure A1-4-4).

Time = 13 minutes.
Distance = 27 Nautical miles.
Fuel = 11 gallons.

Since the takeoff was made from 1500 feet pressure altitude and 20°C. and not sea level density altitude, it is necessary to subtract the quantities required to climb from sea level to the takeoff density altitude. Figure A1-4-4 is entered at the takeoff conditions and these values determine:

Time = 3 mintues.
Distance = 5 nautical miles.
Fuel = 5 gallons.

The time, air distance and fuel for the intended climb are then:

Time = 13 minutes −3 minutes = 10 minutes.
Distance = 27 nautical miles −5 nautical miles = 22 nautical miles.
Fuel = 11 gallons −5 gallons +3.3 gallons = 9.3 gallons.

Note

> The normal fuel required to start, taxi, and takeoff of 3.3 gallons is included in Figure A1-4-4. However, if the climb is not started from sea level density altitude this quantity must be added in the final calculations.

CRUISE.

The cruise power required and resulting fuel consumption are taken from Part 5. The density altitude for the cruise conditions (10,000 feet pressure altitude and 0°C.) is found from Figure A1-1-1 and is 10,300 feet. It is assumed that a cruising true airspeed of 150 knots is desired. The brake horsepower per engine is determined from Figure A1-5-1, as 115 BHP per engine. The fuel consumption for the condition is 9.3 gallons per hour per engine or 18.6 gallons per hour (figure A1-5-2).

To determine the fuel required for the cruise portion of the mission, first find the time in cruise and multiply the time by the fuel consumption rate. For the sample mission the distance to cruise is:

600 nautical miles — 22 nautical miles traveled. During climb = 578 nautical miles.

The time in cruise is determined from ground speed and assuming a 15 knot tailwind, the time is:

578 ÷ 165 = 3.5 hours.

The fuel required to cruise is then 18.6 × 3.5 = 65.1 gallons.

The total fuel required for the mission is then:

65.1 gallons + 9.3 gallons = 74.4 gallons.

The reserve fuel at destination is:

130 gallons − 74.4 gallons = 55.6 gallons.

The power setting for the cruise conditions is taken from Figure A1-2-5 and for a 2200 rpm cruise, 18.3 inches Hg. manifold pressure is required.

LANDING DATA CARD.

The landing data card may now be completed for the estimated conditions at destination.

CONDITIONS.

1. Gross weight = 4830 pounds (takeoff weight) − 445 pounds (fuel consumed 74.4 gallons at 6 pounds per gallon) = 4385 pounds.
2. Runway length = 8000 feet.
3. Wind = North at 10 knots (weather data).
4. Temperature = 25°C. (weather data).
5. Pressure altitude = 2000 feet (weather data).

Landing — Destination.

1. Threshold speed, 1.3 stall speed = 90 mph IAS (Figure A1-4-1 interpolated for 4385 pounds).
2. Minimum landing distance = 825 feet (Figure A1-6-1 with 10 knot headwind).
3. Single-engine rate-of-climb = 270 feet/minute (Figure A1-4-4).

U-3A and U-3B
LANDING DATA CARD

CONDITIONS

Gross Weight 4385 **Lbs.** **Temperature-OAT** 77° **F.** 25° **C.**
Runway Lenght 8000 **Ft.** **Pressure Altitude** 2000 **Ft.**
Wind Direction North **Velocity** 11.5 **MPH**

LANDING-DESTINATION

Threshold Speed 1.3 Stall Speed 90 **MPH IAS**
Landing Distance 825 **Ft.**
Single-Engine Rate-of-Climb 270 **Ft/Min.**

APPENDIX I • SECTION 2

PERFORMANCE DATA

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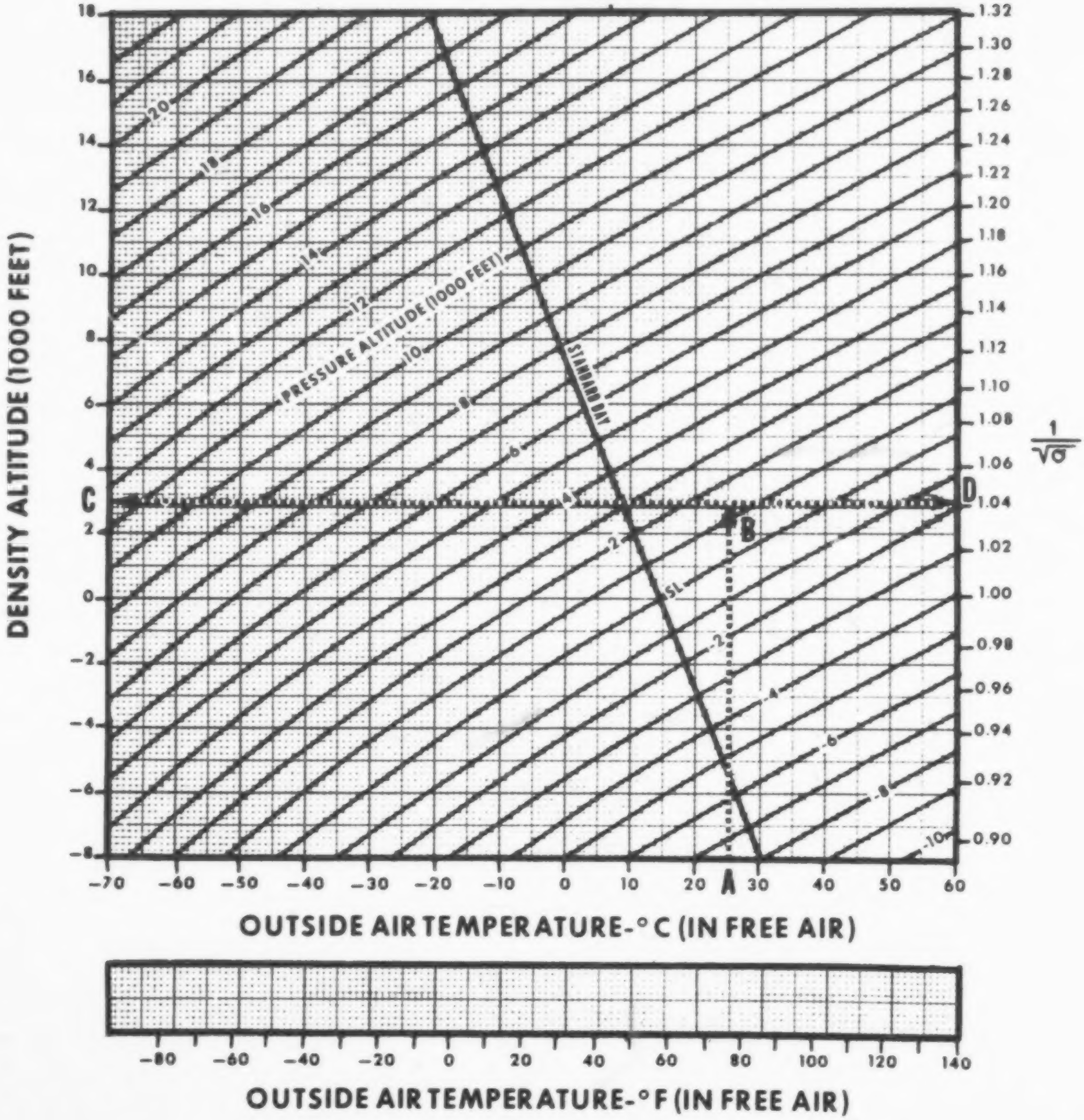
INTRODUCTION.

Section 2 of Appendix I applies to the U-3B aircraft ▲ only. The arrangement of this section is identical with Section 1 and therefore the discussion of the charts, and explanation of the sample problems has been omitted from this section unless differences between the aircraft dictate further explanation.

DENSITY ALTITUDE CHART

EXAMPLE

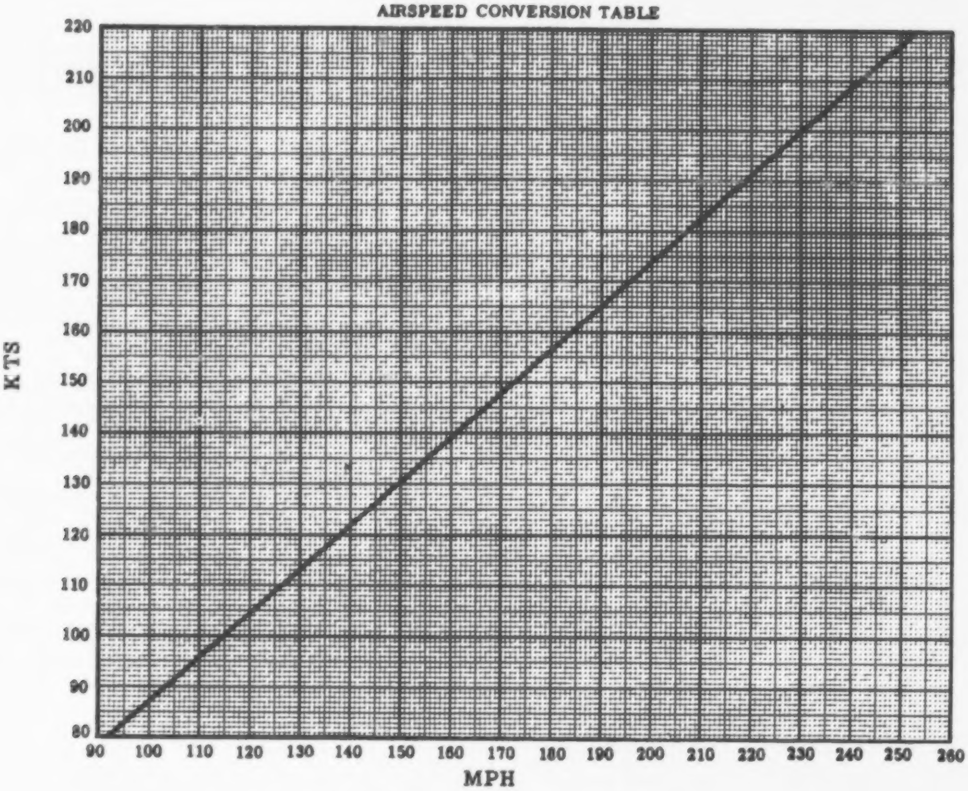
(A) IF AMBIENT TEMPERATURE IS 25°C AND (B) PRESSURE ALTITUDE IS 1500 FEET, (C) THE DENSITY ALTITUDE IS 3000 FEET AND (D) $\frac{1}{\sqrt{\sigma}}$ IS 1.042



NOTE: TO FIND STANDARD DAY, FOLLOW STANDARD DAY LINE TO PRESSURE ALTITUDE, THEN READ STRAIGHT DOWN TO TEMPERATURE SCALE

Figure A2-1-1

AIRSPEED CONVERSION TABLE



TEMPERATURE CONVERSION TABLE

°Cent.	°Fahr.	°Cent.	°Fahr.	°Cent.	°Fahr.	°Cent.	°Fahr.	°Cent.	°Fahr.	°Cent.	°Fahr.
-50	-58.0	-25	-13.0	0	32.0	25	77.0	50	122.0	75	167.0
-49	-56.2	-24	-11.2	1	33.8	26	78.8	51	123.8	76	168.8
-48	-54.4	-23	-9.4	2	35.6	27	80.6	52	125.6	77	170.6
-47	-52.6	-22	-7.6	3	37.4	28	82.4	53	127.4	78	172.4
-46	-50.8	-21	-5.8	4	39.2	29	84.2	54	129.2	79	174.2
-45	-49.0	-20	-4.0	5	41.0	30	86.0	55	131.0	80	176.0
-44	-47.2	-19	-2.2	6	42.8	31	87.8	56	132.8	81	177.8
-43	-45.4	-18	- .4	7	44.6	32	89.6	57	134.6	82	179.6
-42	-43.6	-17	1.4	8	46.4	33	91.4	58	136.4	83	181.4
-41	-41.8	-16	3.2	9	48.2	34	93.2	59	138.2	84	183.2
-40	-40.0	-15	5.0	10	50.0	35	95.0	60	140.0	85	185.0
-39	-38.2	-14	6.8	11	51.8	36	96.8	61	141.8	86	186.8
-38	-36.4	-13	8.6	12	53.6	37	98.6	62	143.6	87	188.6
-37	-34.6	-12	10.4	13	55.4	38	100.4	63	145.4	88	190.4
-36	-32.8	-11	12.2	14	57.2	39	102.2	64	147.2	89	192.2
-35	-31.0	-10	14.0	15	59.0	40	104.0	65	149.0	90	194.0
-34	-29.2	- 9	15.8	16	60.8	41	105.8	66	150.8	91	195.8
-33	-27.4	- 8	17.6	17	62.6	42	107.6	67	152.6	92	197.6
-32	-25.6	- 7	19.4	18	64.4	43	109.4	68	154.4	93	199.4
-31	-23.8	- 6	21.2	19	66.2	44	111.2	69	156.2	94	201.2
-30	-22.0	- 5	23.0	20	68.0	45	113.0	70	158.0	95	203.0
-29	-20.2	- 4	24.8	21	69.8	46	114.8	71	159.8	96	204.8
-28	-18.4	- 3	26.6	22	71.6	47	116.6	72	161.6	97	206.6
-27	-16.6	- 2	28.4	23	73.4	48	118.4	73	163.4	98	208.4
-26	-14.8	- 1	30.2	24	75.2	49	120.2	74	165.2	99	210.2

Figure A2-1-2

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

AIRSPEED POSITION CORRECTION

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

NOTE: ADD CORRECTION TO IAS (INSTRUMENT READING CORRECTED FOR INSTRUMENT ERROR) TO OBTAIN CAS.

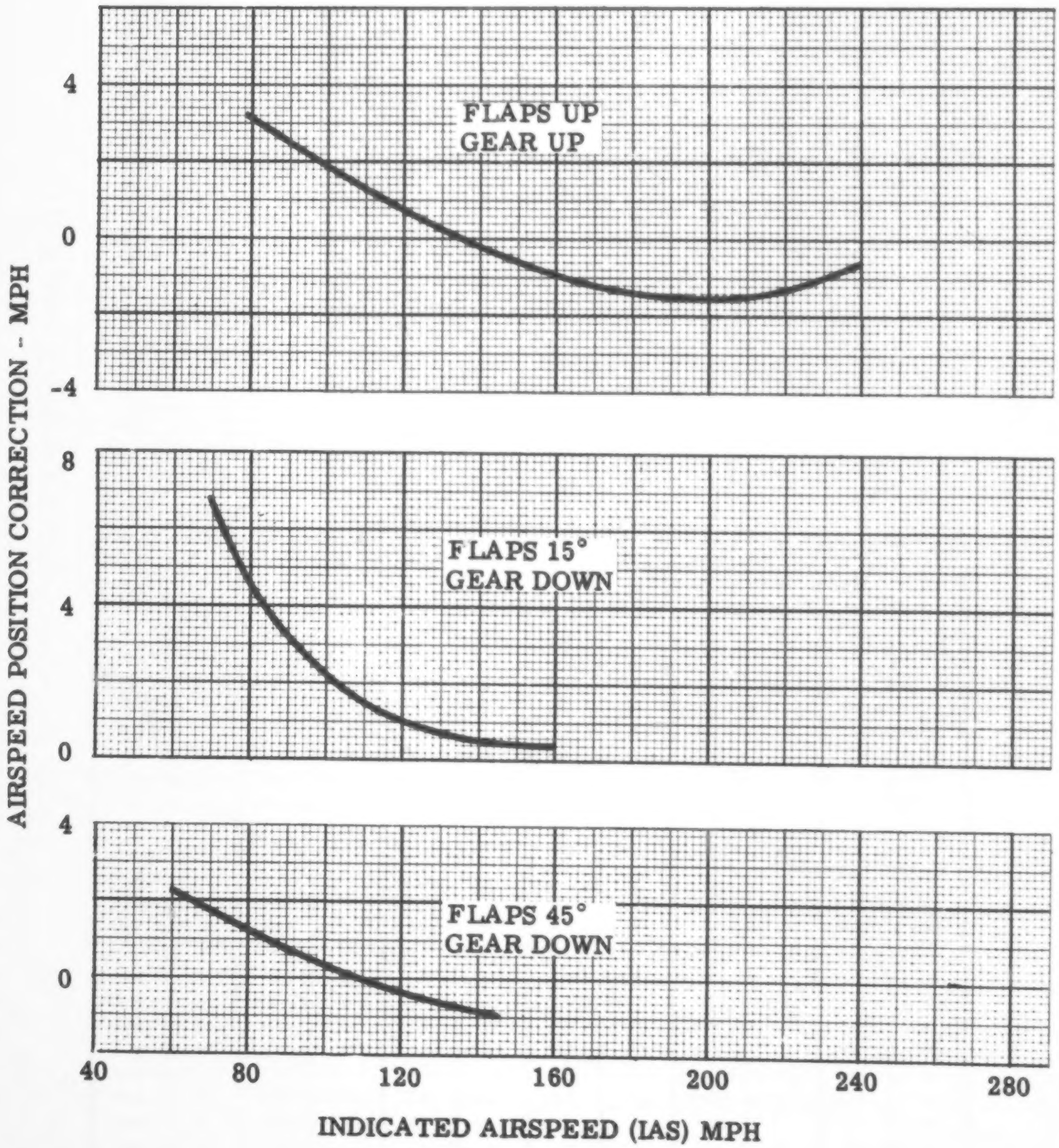


Figure A2-1-3

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INTRODUCTION.

Aircraft ▲ is powered by Continental IO-470-D engines which are rated at 260 brake horsepower at 2625 rpm. These engines are equipped with manifold fuel injection and have no carburetors. The leaning procedure that must be used is explained in Section VII, and is a simple mechanical procedure which requires only that the fuel flow be adjusted to the proper value for the power being produced. The proper fuel flow settings during climbing flight are shown along the vertical scales of the rate-of-climb charts (figures A2-4-1 and A2-4-3) and on the fuel flow gage. The cruise fuel flow settings are shown in figure A2-5-2 and in the fuel pressure gage for a known per cent power.

CAUTION

It is not possible to properly lean the mixture using engine roughness as an indication of the proper setting. See Section VII for further information.

ENGINE OPERATING LIMITS

SEA LEVEL PERFORMANCE

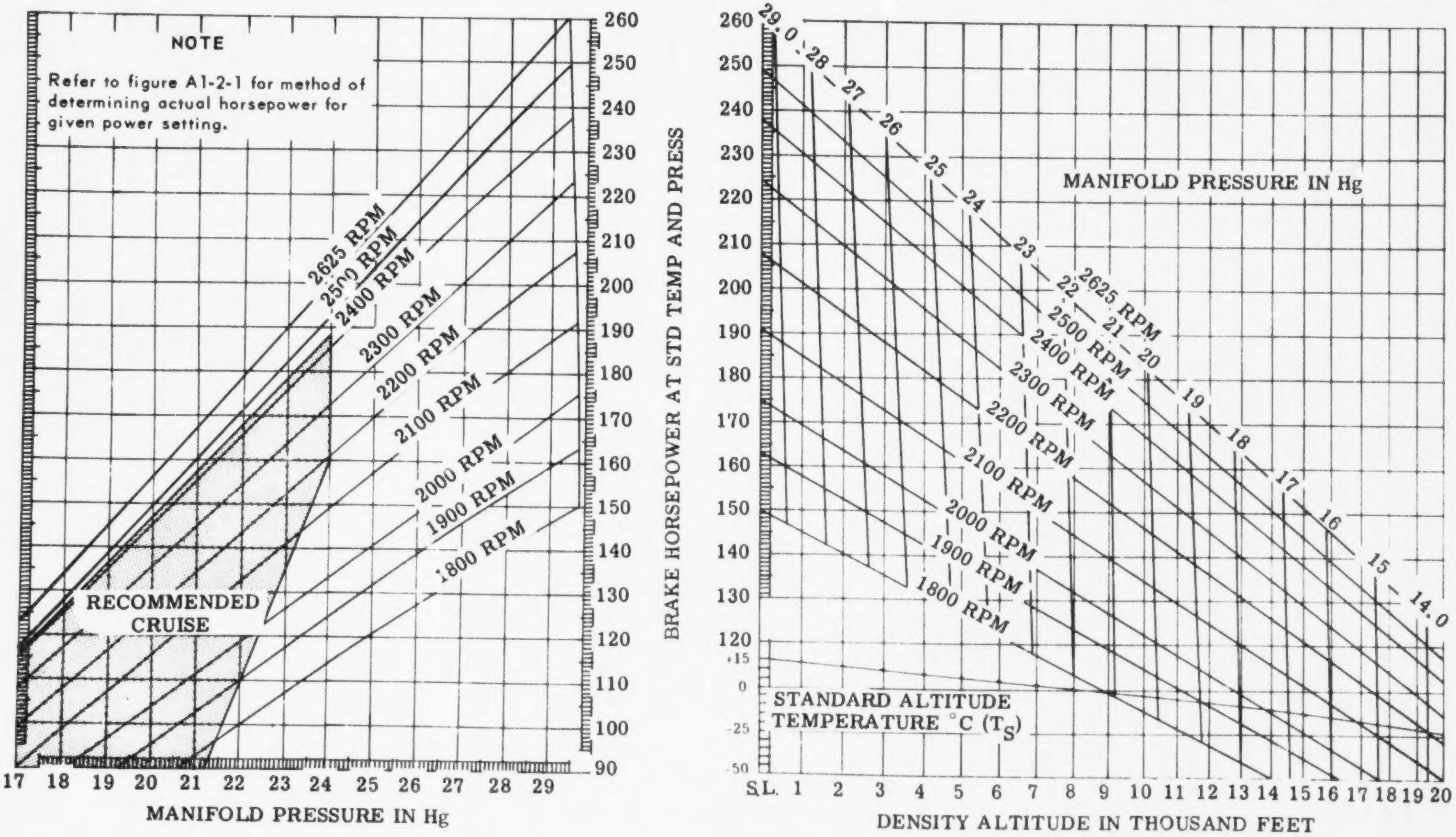
HORSEPOWER vs MANIFOLD PRESSURE

MODEL: U-3B
DATE: 5 MAY 1958
DATA BASIS: CONTINENTIAL MOTORS CORP.

ALTITUDE PERFORMANCE

HORSEPOWER AND MANIFOLD PRESSURE WITHOUT RAM SUBJECT TO ±2.5% VARIATION

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL



NOTE

Refer to figure A1-2-1 for method of determining actual horsepower for given power setting.

Figure A2-2-1

POWER SCHEDULE — 260 TO 195 BHP

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

MIXTURE: APPROXIMATE BEST POWER

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BHP/ENG	PRESS. ALT. (FT)	FUEL FLOW (GAL/HR)	MANIFOLD PRESSURE (In. HG)									RPM
			OUTSIDE AIR TEMPERATURE (°C)									
			-40°	-30°	-20°	-10°	0	10°	20°	30°	40°	
260	SL	41.2	26.8	27.3	27.8	28.4	28.9					2625
	1000	41.2	26.5	27.0	27.5	28.1						2625
	2000	41.2	26.2	26.7								2625
240	SL	37.6	25.1	25.7	26.2	26.7	27.1	27.7	28.1	28.6	29.1	2625
	1000	37.6	24.9	25.4	25.9	26.4	26.9	27.4	27.8			2625
	2000	37.6	24.7	25.2	25.6	26.1	26.6					2625
	3000	37.6	24.4	24.9	25.4	25.9						2625
	4000	37.6	24.2	24.7								2625
220	SL	34.5	23.5	24.0	24.4	24.9	25.3	25.8	26.3	26.7	27.1	2625
	1000	34.5	23.3	23.7	24.2	24.7	25.1	25.6	26.0	26.5	26.9	2625
	2000	34.5	23.0	23.5	23.9	24.4	24.8	25.3	25.7	26.1	26.6	2625
	3000	34.5	22.9	23.4	23.8	24.2	24.7	25.2	25.6	26.0		2625
	4000	34.5	22.8	23.2	23.6	24.1	24.5	25.0				2625
	5000	34.5	22.6	23.0	23.4	23.9						2625
	6000	34.5	22.4	22.8								2625
195	SL	30.6	22.4	22.9	23.3	23.8	24.2	24.6	25.1	25.5	25.9	2450
	1000	30.6	22.2	22.6	23.0	23.5	23.9	24.3	24.7	25.1	25.6	2450
	2000	30.6	22.1	22.5	22.9	23.4	23.8	24.2	24.6	25.0	25.4	2450
	3000	30.6	21.9	22.4	22.8	23.2	23.7	24.1	24.5	24.9	25.3	2450
	4000	30.6	21.8	22.3	22.7	23.1	23.6	24.0	24.4	24.8	25.2	2450
	5000	30.6	21.7	22.2	22.6	23.0	23.5	23.9	23.1	23.5	23.8	2625
	6000	30.6	21.6	22.1	22.5	22.9	23.4	22.6	23.0	23.4		2625
	7000	30.6	21.5	22.0	22.4	21.7	22.1	22.5				2625
	8000	30.6	21.4	20.8	21.2	21.6						2625
	9000	30.6	20.2	20.6	21.0							2625

NOTES:
(1) MAXIMUM RECOMMENDED POWER SETTING FOR CRUISE IS 2450 RPM AND 24 INCHES MANIFOLD PRESSURE.
(2) THE CHART ALLOWS FOR AN AVERAGE INDUCTION AIR HEAT RISE OF 7°C ABOVE OUTSIDE AIR TEMPERATURE.
(3) DATA SHOWN IS ALSO APPLICABLE FOR APPROVED ALTERNATE FUELS.

PROCEDURE: READ FUEL FLOW AND MANIFOLD PRESSURE DIRECTLY OPPOSITE ALTITUDE. READ ENGINE RPM WITHIN BRACKETED AREAS.

Figure A2-2-2

POWER SCHEDULE — 195 TO 180 BHP

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

MIXTURE: NORMAL LEAN

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BHP/ENG	PRESS. ALT. (FT)	FUEL FLOW (GAL/HR)	MANIFOLD PRESSURE (In. HG) OUTSIDE AIR TEMPERATURE (°C) -40	-30	-20	-10	0	10	20	30	40	RPM
195	SL	28.3	22.4	22.9	23.3	23.8	24.2	24.6	25.1	25.5	25.9	2450
	1000	28.3	22.2	22.6	23.0	23.5	23.9	24.3	24.7	25.1	25.6	2450
	2000	28.3	22.1	22.5	22.9	23.4	23.8	24.2	24.6	25.0	25.4	2450
	3000	28.3	21.9	22.4	22.8	23.2	23.7	24.1	24.5	24.9	25.3	2450
	4000	28.3	21.8	22.3	22.7	23.1	23.6	24.0	24.4	24.8	25.2	2450
	5000	28.3	21.7	22.2	22.6	23.0	23.5	23.9	23.1	23.5	23.8	2625
	6000	28.3	21.6	22.1	22.5	22.9	23.4	22.6	23.0	23.4		2625
	7000	28.3	21.5	22.0	22.4	21.7	22.1	22.5				2625
	8000	28.3	21.4	20.8	21.2	21.6						2625
	9000	28.3	20.2	20.6	21.0							2625
180	SL	26.0	21.2	21.6	22.1	22.5	22.9	23.3	23.7	24.1	24.5	2450
	1000	26.0	21.0	21.4	21.8	22.3	22.7	23.1	23.5	23.9	24.2	2450
	2000	26.0	20.9	21.3	21.7	22.1	22.5	22.9	23.4	23.7	24.1	2450
	3000	26.0	20.7	21.1	21.5	21.9	22.3	22.7	23.1	23.5	23.9	2450
	4000	26.0	20.6	21.0	21.4	21.8	22.2	22.6	23.0	23.4	23.7	2450
	5000	26.0	20.5	20.9	21.3	21.7	22.1	22.5	22.9	23.3	23.6	2450
	6000	26.0	20.4	20.8	21.2	21.6	21.9	22.4	22.7	23.1	22.3	2625
	7000	26.0	20.2	20.7	21.1	21.5	21.8	22.2	22.6	21.8	22.2	2625
	8000	26.0	20.1	20.5	20.9	21.3	21.7	20.9	21.3	21.7		2625
	9000	26.0	19.9	20.3	20.7	20.1	20.5	20.8				2625
	10000	26.0	19.8	19.2	19.6	20.0						2625
	11000	26.0	18.6	19.0								2625

NOTES:
(1) Maximum recomended power setting for cruise is 2450 RPM and 24 inches manifold pressure.
(2) The chart allows for an average induction air heat rise of 7°C above outside air temperature.
(3) Data shown is also applicable for approved alternate fuels.

PROCEDURE: Read fuel flow and manifold pressure directly opposite altitude.
Read engine RPM within bracketed areas.

Figure A2-2-3

POWER SCHEDULE — 160 TO 140 BHP

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

MIXTURE: NORMAL LEAN

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BHP ENG	PRESS. ALT. (FT)	FUEL FLOW (GAL/HR)	MANIFOLD PRESSURE (In. HG)									RPM
			OUTSIDE AIR TEMPERATURE (°C)									
			-40	-30	-20	-10	0	10	20	30	40	
160	SL	23.0	21.8	22.3	22.7	23.2	23.5	24.0	24.4	24.8	25.2	2200
	1000	23.0	21.7	22.1	22.5	23.0	23.5	23.9	24.3	24.7	25.1	2200
	2000	23.0	21.6	22.0	22.4	22.9	23.3	23.8	24.2	24.6	25.0	2200
	3000	23.0	21.4	21.8	22.3	22.7	23.1	23.6	23.9	24.3	24.7	2200
	4000	23.0	21.3	21.8	22.2	22.6	23.0	23.4	23.8	24.2	24.6	2200
	5000	23.0	21.2	21.6	22.1	22.5	22.9	23.3	23.7	24.1	23.2	2300
	6000	23.0	21.1	21.5	21.9	22.4	22.8	23.2	22.3	22.7	23.1	2300
	7000	23.0	21.0	21.4	21.8	22.3	22.6	21.8	22.2	22.6	21.2	2450
	8000	23.0	20.9	21.3	21.7	20.9	21.3	21.7	20.4	20.7	21.0	2450
	9000	23.0	20.8	20.0	20.4	20.8	19.6	19.9	20.3	20.6	19.7	2625
	10000	23.0	19.5	19.9	18.8	19.2	19.5	19.8	19.2	19.5	19.8	2625
	11000	23.0	18.0	18.3	18.7	19.1	18.4	18.7	19.0			2625
	12000	23.0	17.9	18.2	17.7	18.0	18.3					2625
	13000	23.0	16.9	17.3	17.6							2625
140	SL	20.3	20.9	21.3	21.7	22.2	22.6	23.0	23.4	23.8	24.1	2100
	1000	20.3	20.8	21.2	21.6	22.1	22.5	22.9	23.3	23.6	24.0	2100
	2000	20.3	20.7	21.1	21.5	22.0	22.3	22.8	23.1	23.5	23.9	2100
	3000	20.3	20.6	21.0	21.4	21.8	22.2	22.6	23.0	23.4	23.8	2100
	4000	20.3	20.5	20.9	21.3	21.7	22.1	22.5	22.9	23.3	23.6	2100
	5000	20.3	20.4	20.8	21.2	21.6	22.0	22.4	22.8	23.2	23.5	2100
	6000	20.3	20.3	20.7	21.1	21.5	21.9	22.3	22.7	23.1	23.4	2100
	7000	20.3	20.2	20.6	21.0	21.4	21.8	22.2	22.6	21.3	21.6	2200
	8000	20.3	20.1	20.5	20.9	21.3	21.7	20.5	20.8	21.2	21.5	2200
	9000	20.3	20.0	20.3	20.8	19.6	20.0	20.3	20.7	20.0	20.4	2300
	10000	20.3	19.8	18.8	19.2	19.5	19.9	19.3	19.6	19.9	18.9	2450
	11000	20.3	18.4	18.7	19.1	18.4	18.8	19.1	18.2	18.5	18.8	2450
	12000	20.3	18.2	17.7	18.1	18.4	17.4	17.7	18.0	18.3	17.8	2625
	13000	20.3	17.3	17.6	16.7	17.0	17.3	17.6	17.1	17.4	17.7	2625
	14000	20.3	17.2	16.3	16.5	16.9	17.2	16.8	17.0			2625
	15000	20.3	15.9	16.1	16.4	16.1	16.4	16.6,				2625
	16000	20.3	15.7	15.9	15.7	15.9						2625

NOTES:
(1) Maximum recommended power setting for cruise is 2450 RPM and 24 inches manifold pressure.
(2) The chart allows for an average induction air heat rise of 7°C above outside air temperature.
(3) Data shown is also applicable for approved alternate fuels.

PROCEDURE: Read fuel flow and manifold pressure directly opposite altitude.
Read engine RPM within bracketed areas.

Figure A2-2-4

POWER SCHEDULE — 120 BHP

MIXTURE: NORMAL LEAN

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BHP/ENG	PRESS. ALT. (FT)	FUEL FLOW (GAL/HR)	MANIFOLD PRESSURE (In. HG)									RPM
			OUTSIDE AIR TEMPERATURE (°C)									
			-40°	-30°	-20°	-10°	0	10°	20°	30°	40°	
120	SL	17.8	18.8	19.2	19.6	20.0	20.3	20.7	21.0	21.4	21.7	2100
	1000	17.8	18.6	19.0	19.4	19.7	20.1	20.5	20.8	21.1	21.5	2100
	2000	17.8	18.5	18.9	19.2	19.6	20.0	20.3	20.7	21.0	21.4	2100
	3000	17.8	18.4	18.7	19.1	19.5	19.8	20.2	20.5	20.9	21.2	2100
	4000	17.8	18.3	18.6	19.0	19.4	19.7	20.1	20.4	20.8	21.1	2100
	5000	17.8	18.2	18.5	18.9	19.2	19.6	19.9	20.3	20.6	20.9	2100
	6000	17.8	18.0	18.4	18.7	19.1	19.4	19.8	20.1	20.5	20.8	2100
	7000	17.8	17.9	18.3	18.6	19.0	19.3	19.7	20.0	20.3	20.6	2100
	8000	17.8	17.8	18.1	18.5	18.8	19.2	19.5	19.9	20.2	20.5	2100
	9000	17.8	17.7	18.0	18.4	18.8	19.1	19.4	19.8	20.1	20.4	2100
	10000	17.8	17.6	17.9	18.3	18.7	19.0	19.4	19.7	20.0	20.3	2100
	11000	17.8	17.5	17.8	18.2	18.5	18.8	19.2	19.5	18.6	18.9	2200
	12000	17.8	17.4	17.7	18.1	18.4	18.7	17.9	18.1	18.4	18.7	2200
	13000	17.8	17.2	17.5	18.0	17.2	17.5	17.8	17.2	17.5	17.8	2300
	14000	17.8	17.1	16.4	16.7	17.0	16.5	16.8	17.1	16.3	16.6	2450
	15000	17.8	16.0	16.3	16.6	16.2	16.5	16.7	16.0	16.2	16.5	2450
	16000	17.8	15.9	15.5	15.8	16.1	15.3	15.5	15.8	15.4	15.6	2625
	17000	17.8	15.0	15.3	14.7	14.9	15.2	14.9	15.1	15.3		2625
	18000	17.8	13.9	14.2	14.5	14.3	14.5	14.8				2625
	19000	17.8	13.8	13.6	13.9	14.1						2625
	20000	17.8	13.3	13.5								2625

NOTES:
(1) Maximum recommended power setting for cruise is 2450 RPM and 24 inches manifold pressure.
(2) The chart allows for an average induction air heat rise of 7°C above outside air temperature.
(3) Data shown is also applicable for approved alternate fuels.

PROCEDURE: Read fuel flow and manifold pressure directly opposite altitude.
Read engine RPM within bracketed areas.

Figure A2-2-5

POWER SCHEDULE — 100 BHP

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

MIXTURE: NORMAL LEAN

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BHP/ENG	PRESS. ALT. (FT)	FUEL FLOW (GAL/HR)	MANIFOLD PRESSURE (In. HG) OUTSIDE AIR TEMPERATURE (°C)									RPM
			-40°	-30°	-20°	-10°	0	10°	20°	30°	40°	
100	SL	15.6	16.6	16.9	17.3	17.6	17.9	18.3	18.6	18.9	19.2	2100
	1000	15.6	16.5	16.8	17.2	17.5	17.8	18.1	18.4	18.7	19.0	2100
	2000	15.6	16.4	16.7	17.0	17.4	17.7	18.0	18.3	18.6	18.9	2100
	3000	15.6	16.3	16.6	16.9	17.2	17.5	17.9	18.2	18.5	18.8	2100
	4000	15.6	16.0	16.4	16.7	17.0	17.3	17.6	17.9	18.2	18.5	2100
	5000	15.6	15.9	16.2	16.5	16.9	17.2	17.5	17.8	18.1	18.3	2100
	6000	15.6	15.8	16.1	16.4	16.7	17.0	17.3	17.6	17.9	18.2	2100
	7000	15.6	15.7	16.0	16.3	16.6	16.9	17.2	17.5	17.8	18.1	2100
	8000	15.6	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	2100
	9000	15.6	15.5	15.8	16.1	16.4	16.7	17.0	17.3	17.6	17.9	2100
	10000	15.6	15.4	15.7	16.0	16.3	16.6	16.9	17.2	17.4	17.7	2100
	11000	15.6	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.3	17.5	2100
	12000	15.6	15.2	15.5	15.8	16.1	16.4	16.7	17.0	17.2	17.4	2100
	13000	15.6	15.1	15.4	15.7	16.0	16.3	16.6	16.9	17.1	17.3	2100
	14000	15.6	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.0	17.2	2100
	15000	15.6	14.9	15.2	15.5	15.8	16.1	16.4	16.7	16.0	16.3	2200
	16000	15.6	14.8	15.1	15.4	15.7	16.0	15.3	15.6	15.8	15.5	2300
	17000	15.6	14.7	15.0	15.3	14.7	15.0	15.2	14.9	15.1	15.4	2300
	18000	15.6	14.6	14.0	14.3	14.6	14.3	14.5	14.7	14.1	14.3	2450
	19000	15.6	13.6	13.9	13.7	13.9	14.2	13.5	13.7	13.9	14.1	2450
	20000	15.6	13.5	13.3	13.5	12.8	13.1	13.3	13.5	13.7		2450

NOTES:
(1) Maximum recommended power setting for cruise is 2450 RPM and 24 inches manifold pressure.
(2) The chart allows for an average induction air heat rise of 7°C above outside air temperature.
(3) Data shown is also applicable for approved alternate fuels.

PROCEDURE: Read fuel flow and manifold pressure directly opposite altitude.
Read engine RPM within bracketed areas.

Figure A2-2-6

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INTRODUCTION.

The takeoff performance charts in this part are of the same construction as those contained in Section 1, Part 3. Refer to Section 1, Part 3 for explanations and discussion.

TAKEOFF AND LANDING CROSSWIND CHART

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ENGINES: (2) 10-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

NOTE: ENTER CHART WITH MAXIMUM GUST VELOCITY

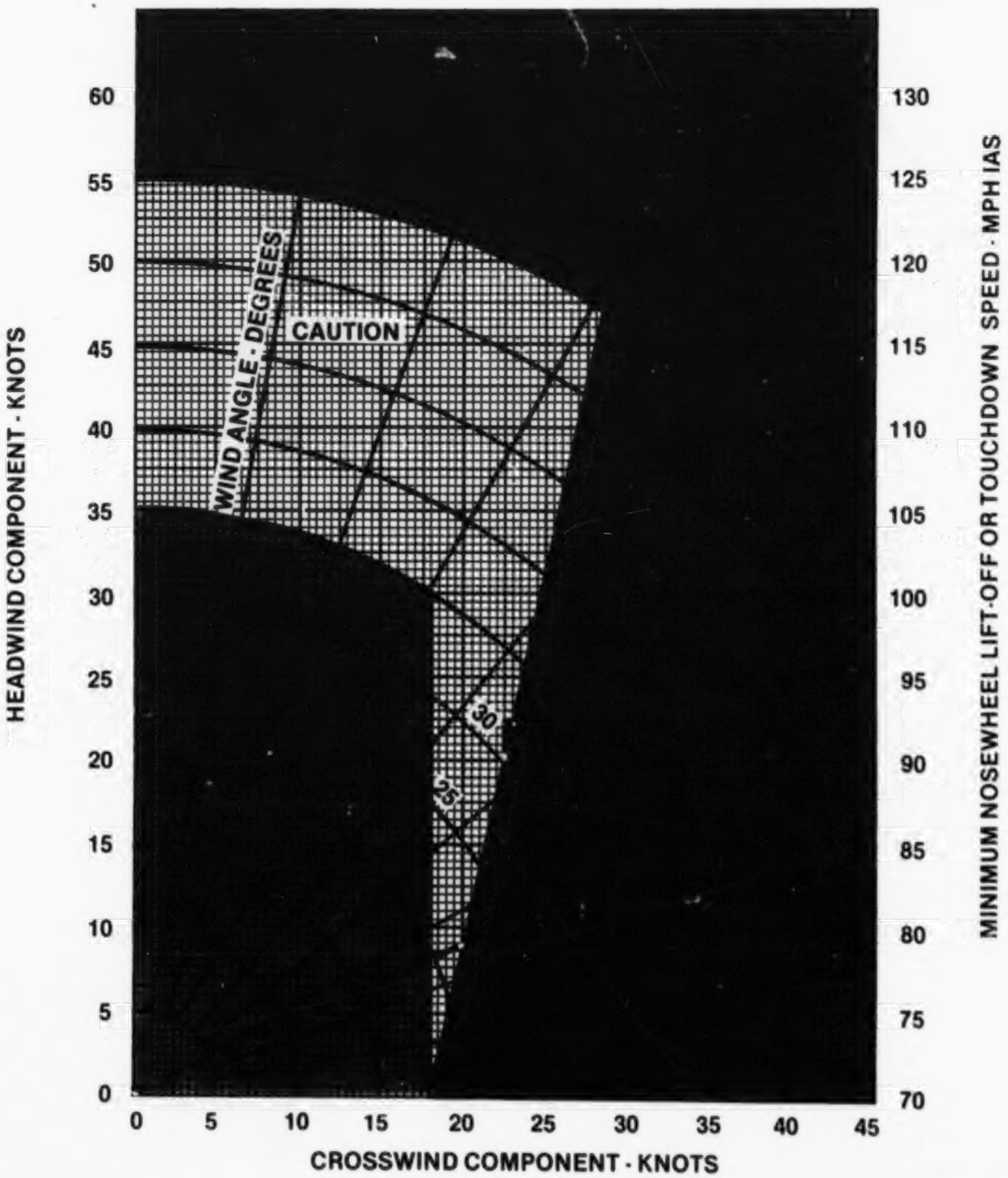


Figure A2-3-1

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

NORMALTAKEOFF GROUND RUN

ENGINES: (2) I0-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:
1. FLAPS RETRACTED
2. FULL POWER
3. HARD SURFACT RUNWAY
4. TAKEOFF AT 95 MPH IAS

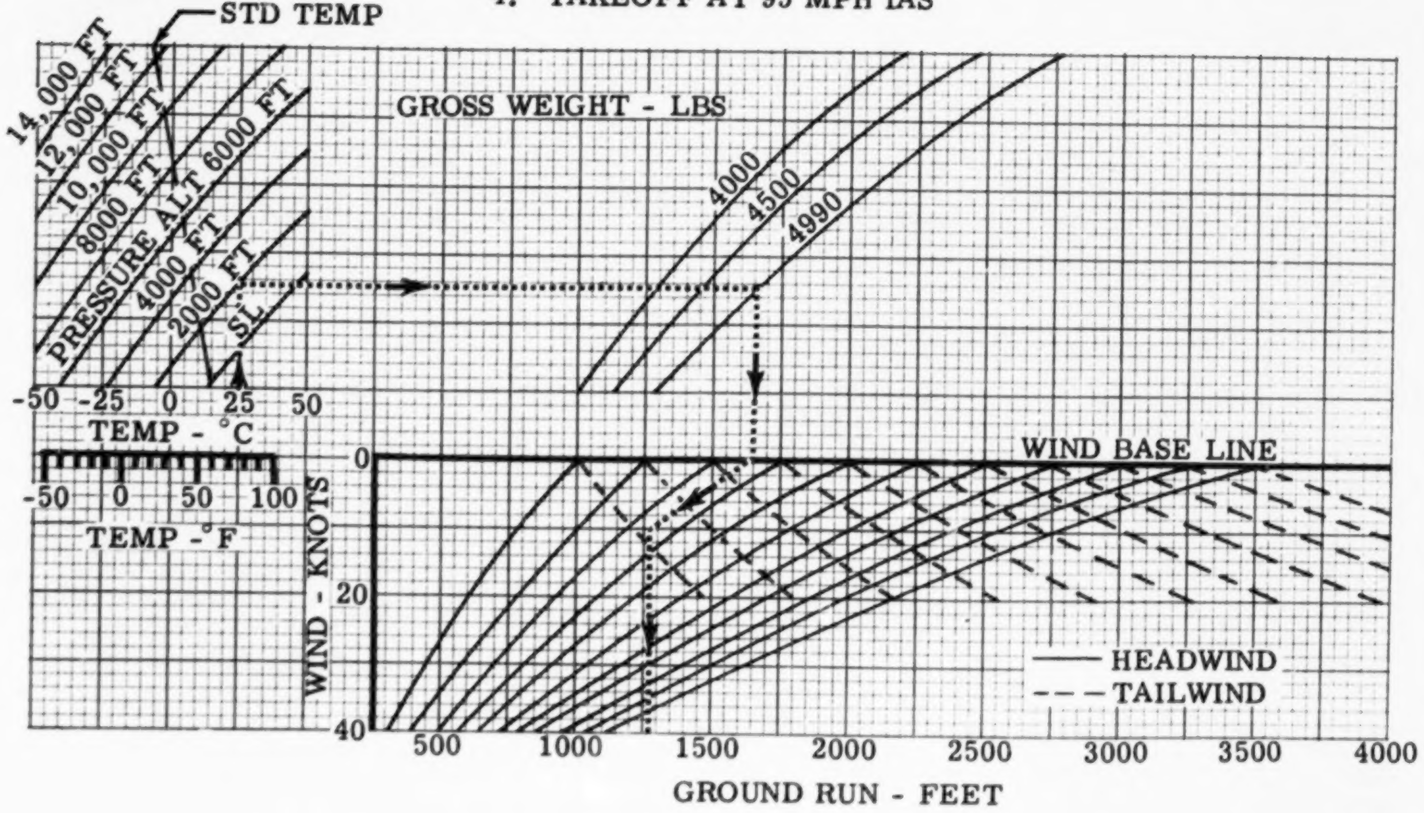


Figure A2-3-2

MAXIMUM PERFORMANCE TAKEOFF DISTANCE

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

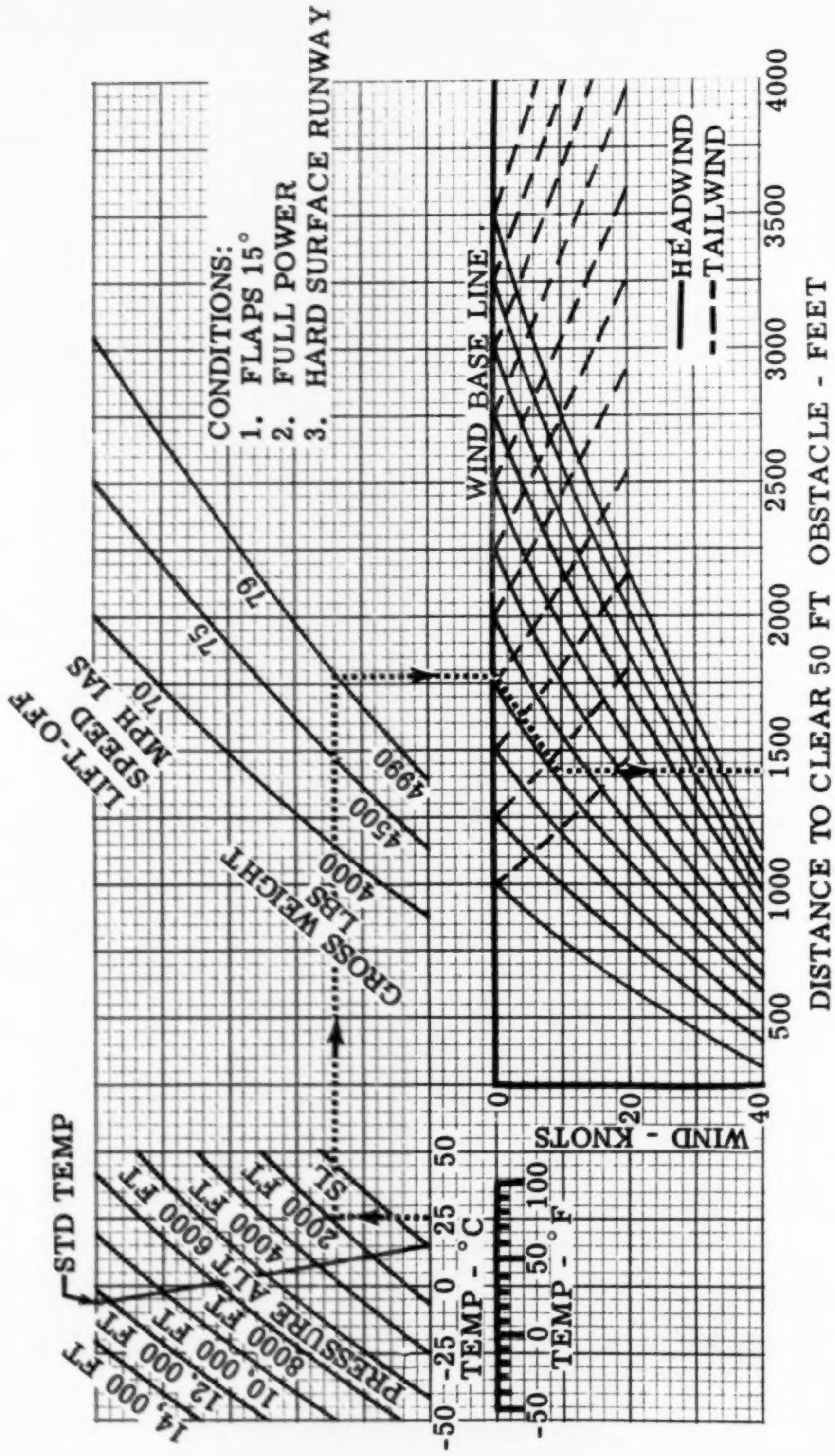
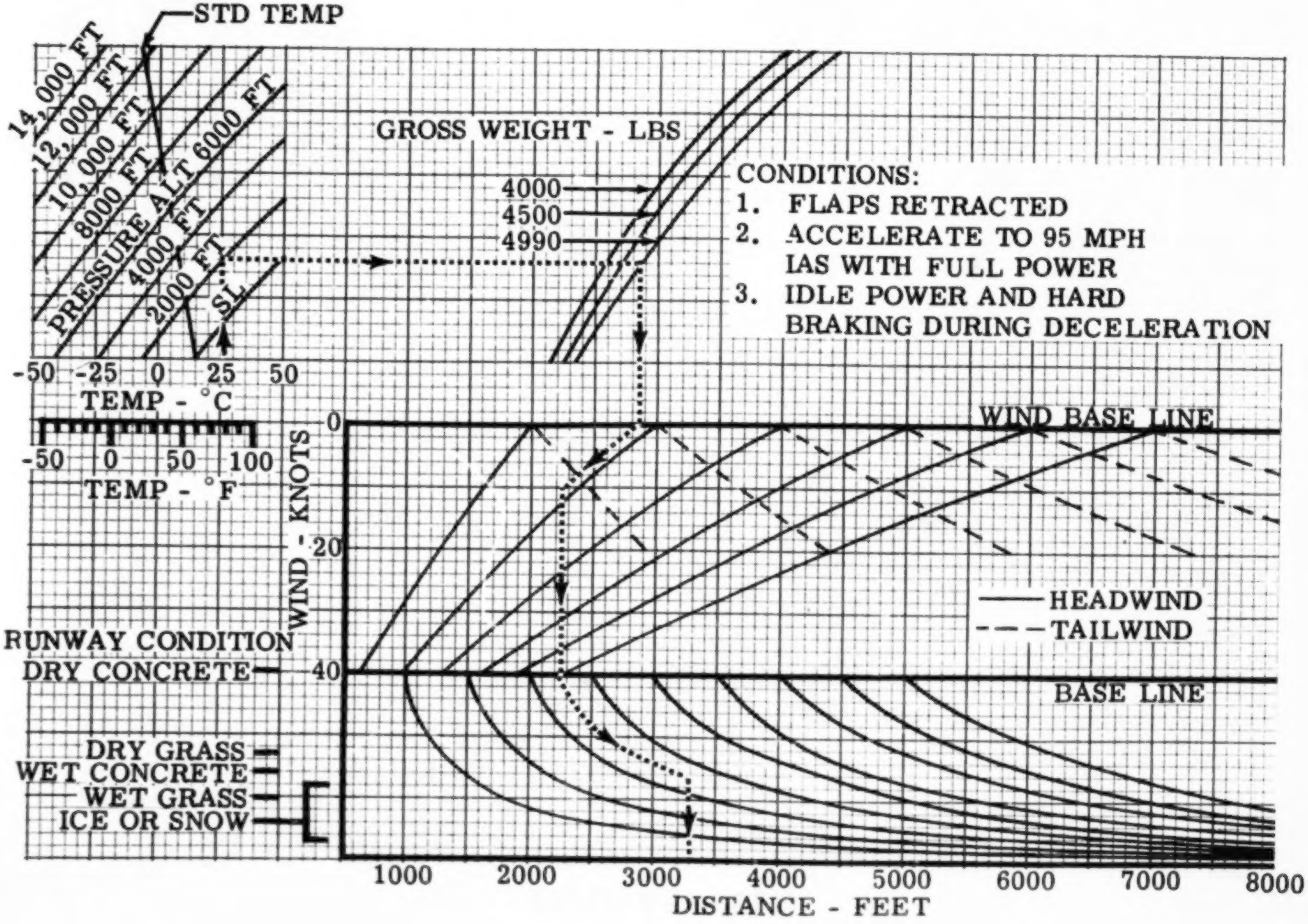


Figure A2-3-3

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ACCELERATE AND STOP DISTANCE

ENGINES: (2) I0-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL



CONDITIONS:
1. FLAPS RETRACTED
2. ACCELERATE TO 95 MPH IAS WITH FULL POWER
3. IDLE POWER AND HARD BRAKING DURING DECELERATION

Figure A2-3-4

REFUSAL SPEED

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:
1. FLAPS UP OR 15° DURING ACCELERATION
2. FULL POWER DURING ACCELERATION
3. FLAPS UP AND HARD BRAKING DURING DECELERATION

NOTE
Minimum Safe Single-Engine Airspeed - 95 MPH IAS

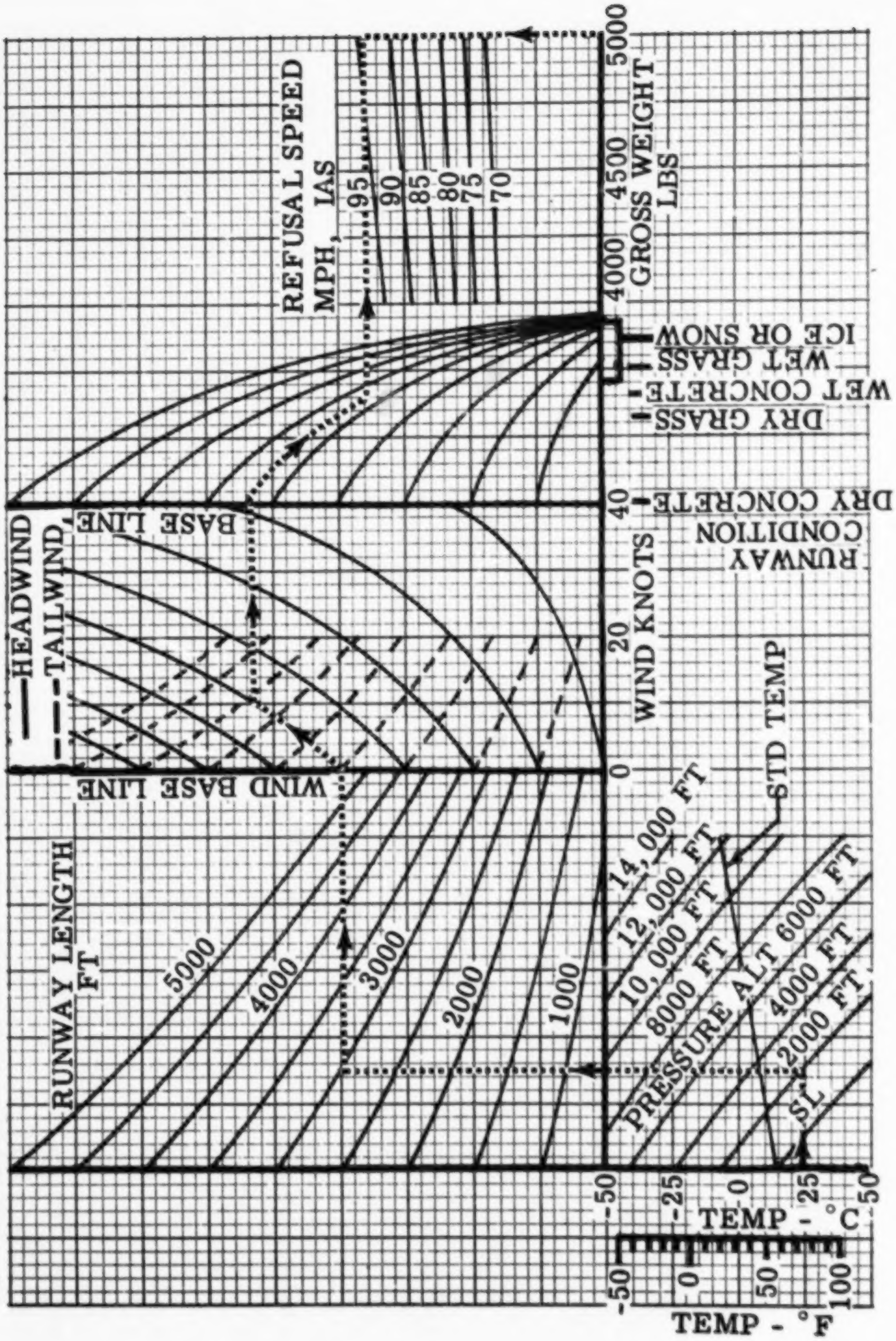


Figure A2-3-5

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

TAKEOFF GROSS WEIGHT LIMIT

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:

1. ONE ENGINE OPERATING AT MAXIMUM POWER
2. PROPELLER ON FAILED ENGINE FEATHERED
3. GEAR AND FLAPS RETRACTED
4. 95 MPH IAS

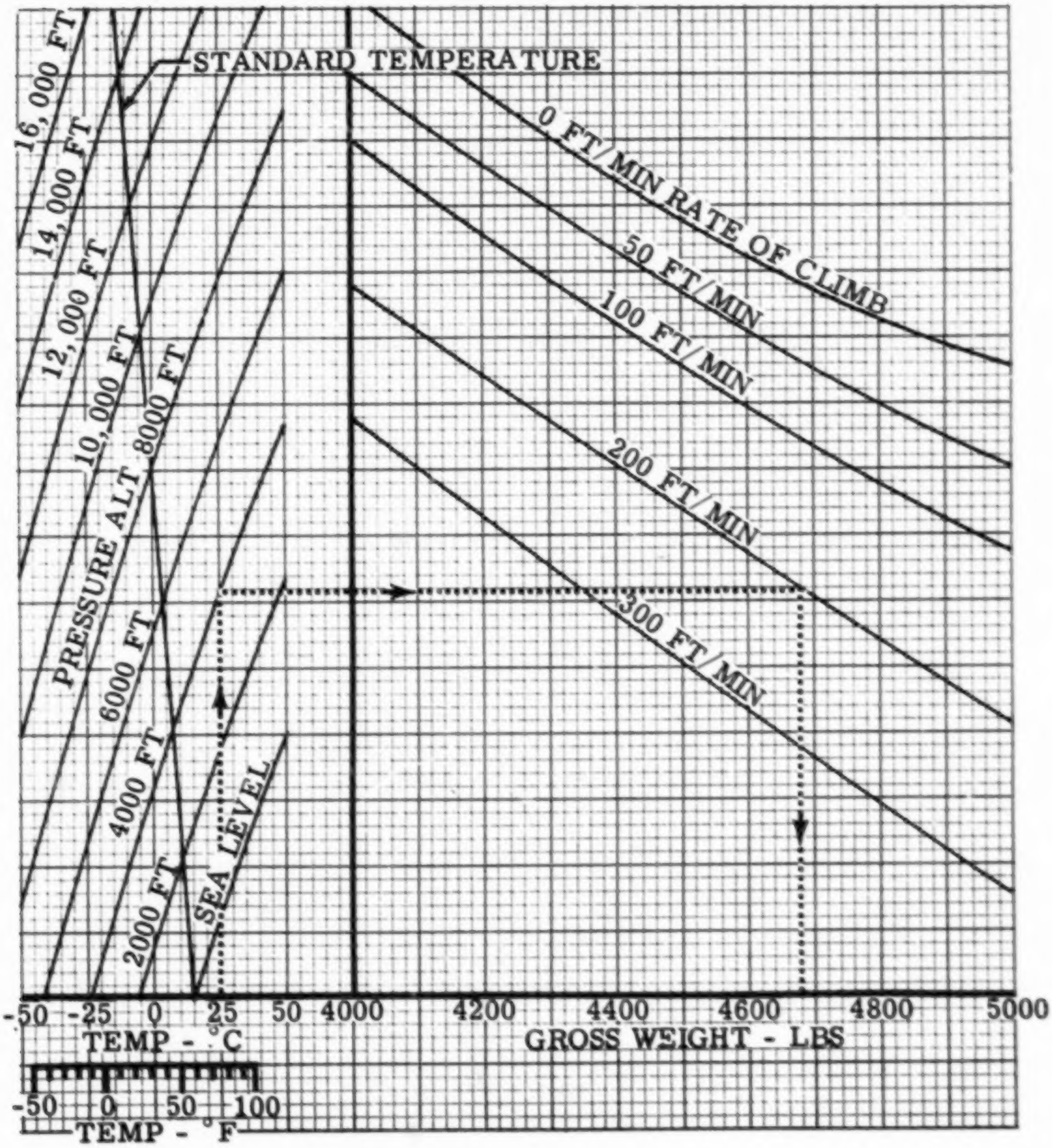


Figure A2-3-6

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INTRODUCTION.

Refer to Section 1, Part 4 for explanation of the charts.

DISCUSSION OF THE CHARTS.

Aircraft ▲ is powered by Continental IO-470-D fuel injection engines which require a different leaning technique than carbureted engines (See Section VII). The correct fuel flow settings during climb are included in this part on the rate-of-climb charts, figures A2-4-1 and A2-4-3. The fuel flow should be adjusted to the recommended setting at 2000 feet intervals during climb.

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

RATE-OF-CLIMB
MAXIMUM POWER
2625 RPM, FULL THROTTLE

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CLIMB SPEEDS - 5000 LBS

DECREASE SPEEDS 1 MPH FOR EACH 100 LBS

ALT	SL	5000	10,000	15,000	20,000
IAS-MPH	122	120	118	116	114
IAS-KTS	106	104	102	100	99

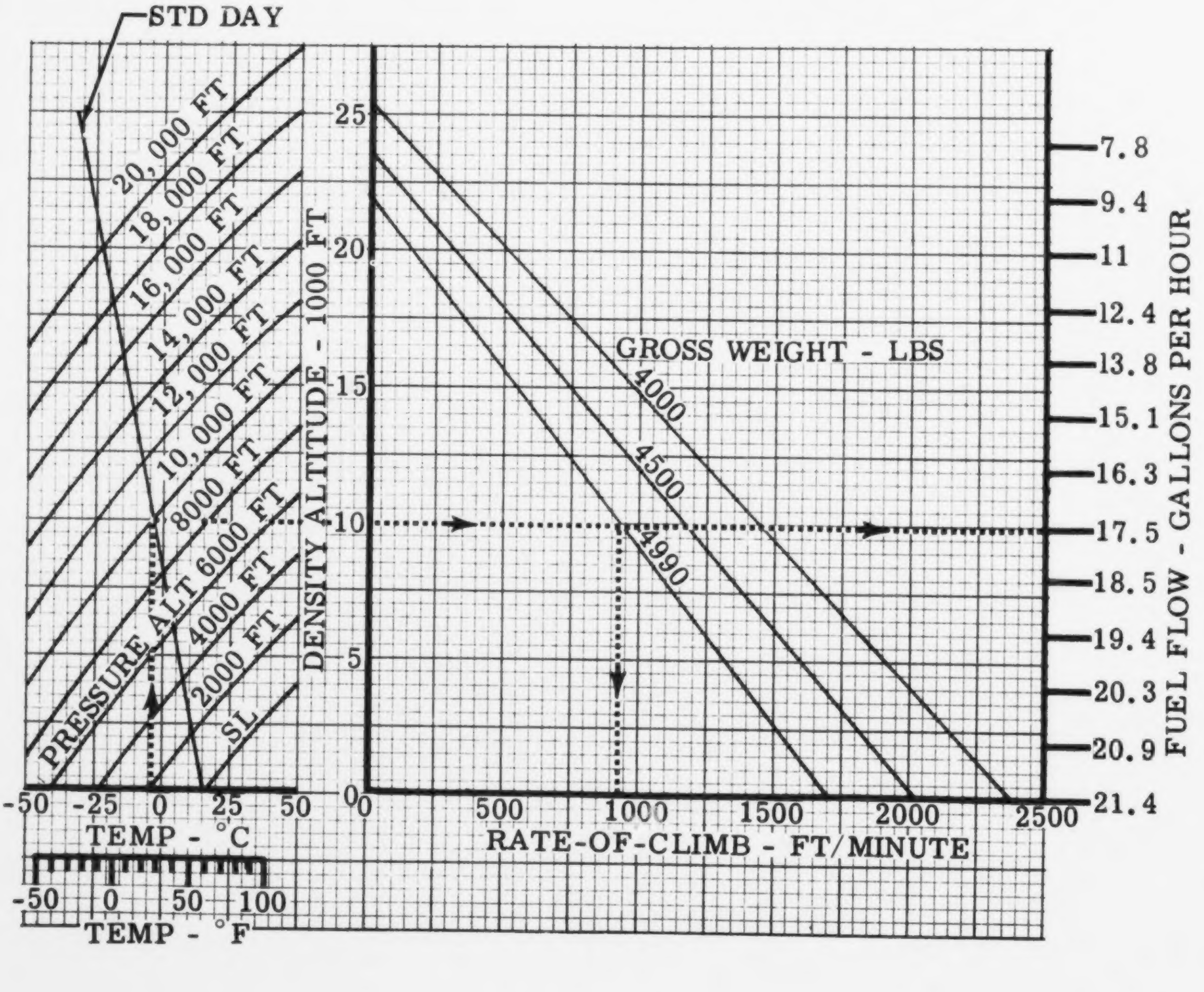

Figure A2-4-1

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

MAXIMUM POWER CLIMB PERFORMANCE

2625 RPM, FULL THROTTLE

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:

1. 2625 RPM
2. FULL THROTTLE
3. SEE FIGURE A2-4-1 FOR FUEL FLOW SETTINGS

NOTES: (1) REFER TO FIGURE A2-4-1 FOR CLIMB SPEEDS
(2) FUEL USED INCLUDES 4.0 GAL FOR TAXI AND TAKEOFF

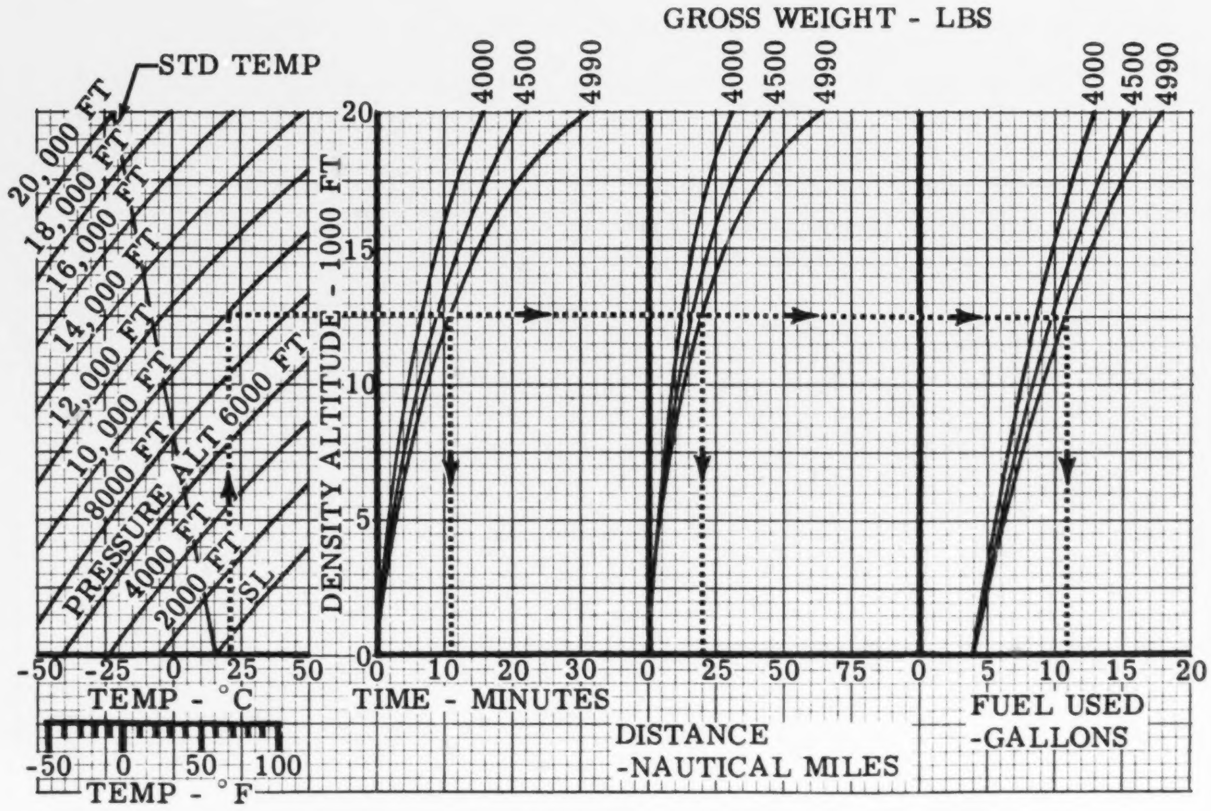

Figure A2-4-2

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

RATE-OF-CLIMB

2450 RPM

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:

1. 24 INCHES MANIFOLD PRESSURE BELOW 5000 FT AND FULL THROTTLE ABOVE 5000 FT
2. CLIMB SPEED - 130 MPH IAS (113 KTS IAS)

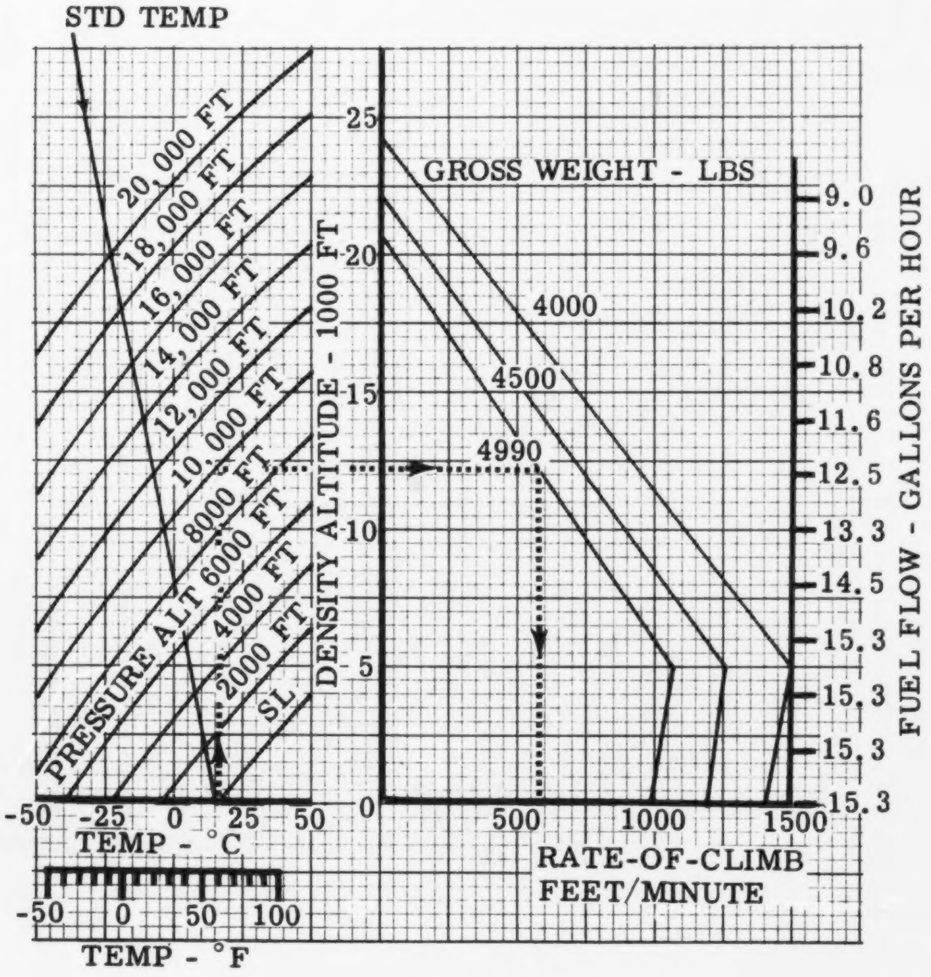

Figure A2-4-3

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

CLIMB PERFORMANCE

2450 RPM

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:

1. 24 INCHES MANIFOLD PRESSURE BELOW 5000 FT, FULL THROTTLE ABOVE 5000 FT
2. CLIMB SPEED - 130 MPH IAS
3. REFER TO FIGURE A2-4-3 FOR FUEL FLOW SETTING

NOTE: FUEL INCLUDES 4 GAL FOR TAXI AND TAKEOFF

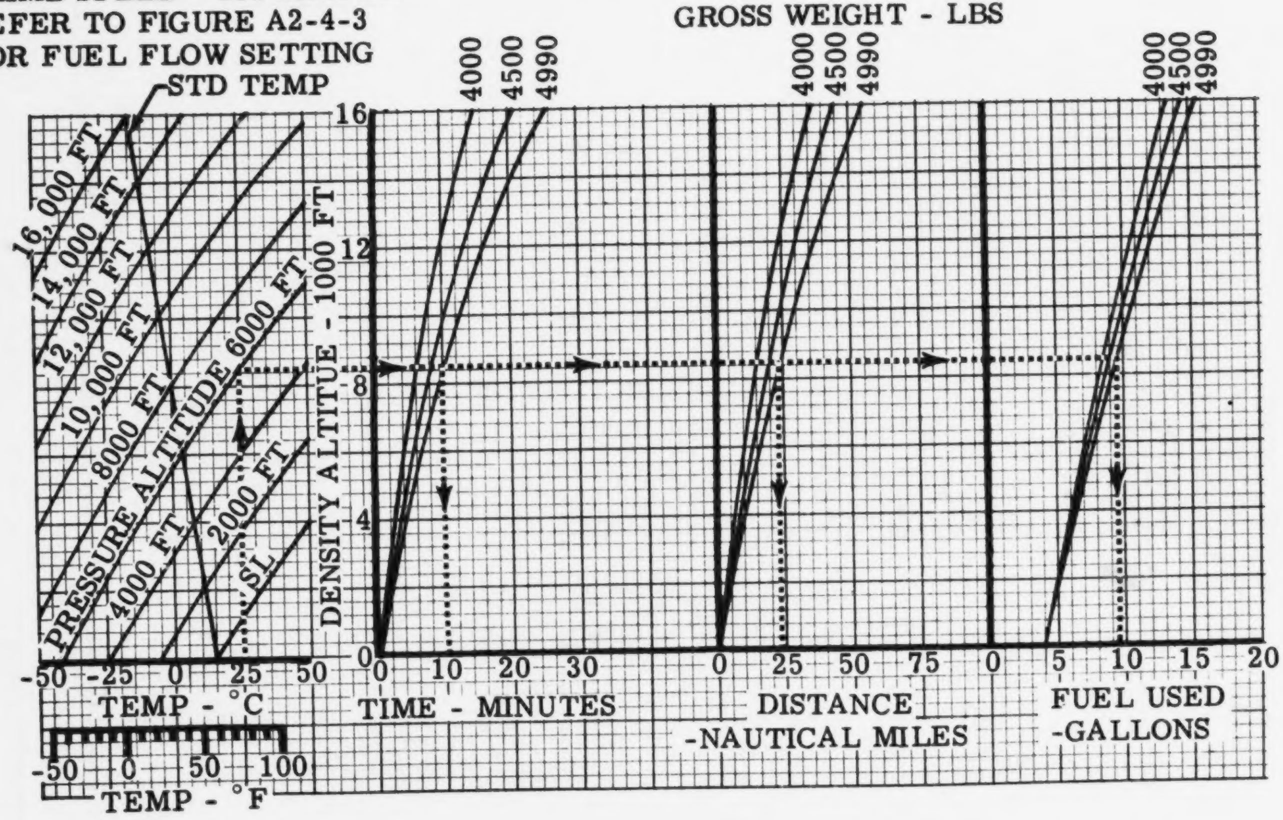

Figure A2-4-4

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

SINGLE-ENGINE CLIMB

MAXIMUM POWER

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:

1. 2625 RPM - FULL THROTTLE
2. PROPELLER ON INOPERATING ENGINE FEATHERED
3. GEAR AND FLAPS UP
4. REFER TO FIGURE A2-4-1 FOR FUEL PRESSURE SETTINGS

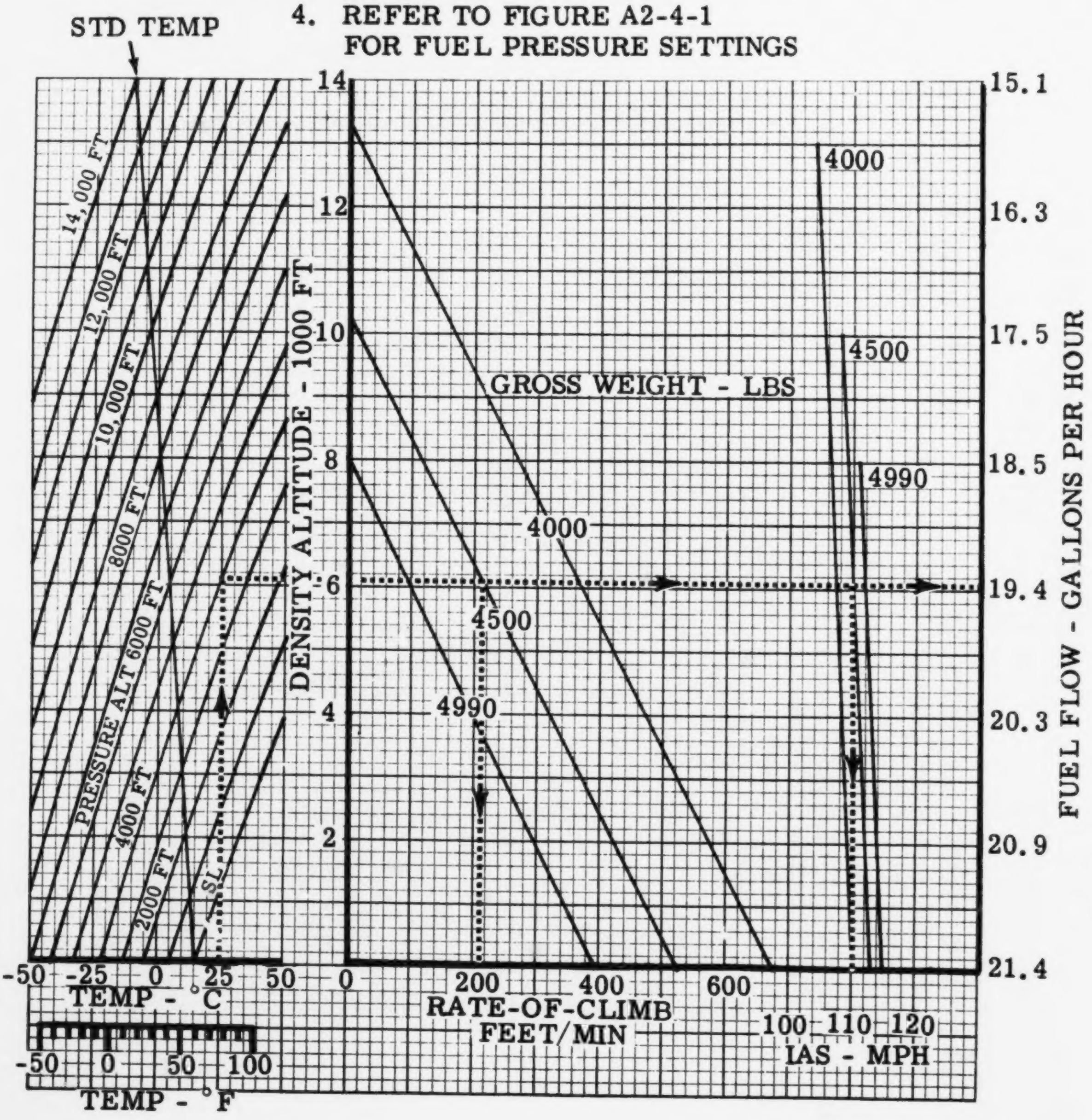

Figure A2-4-5

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

SINGLE-ENGINE DRIFT DOWN TO ABSOLUTE CEILING

(ZERO FEET PER MINUTE)

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

CONDITIONS:
1. PROPELLER ON INOPERATIVE ENGINE FEATHERED
2. MAXIMUM POWER ON OPERATING ENGINE
3. FLAPS AND GEAR UP

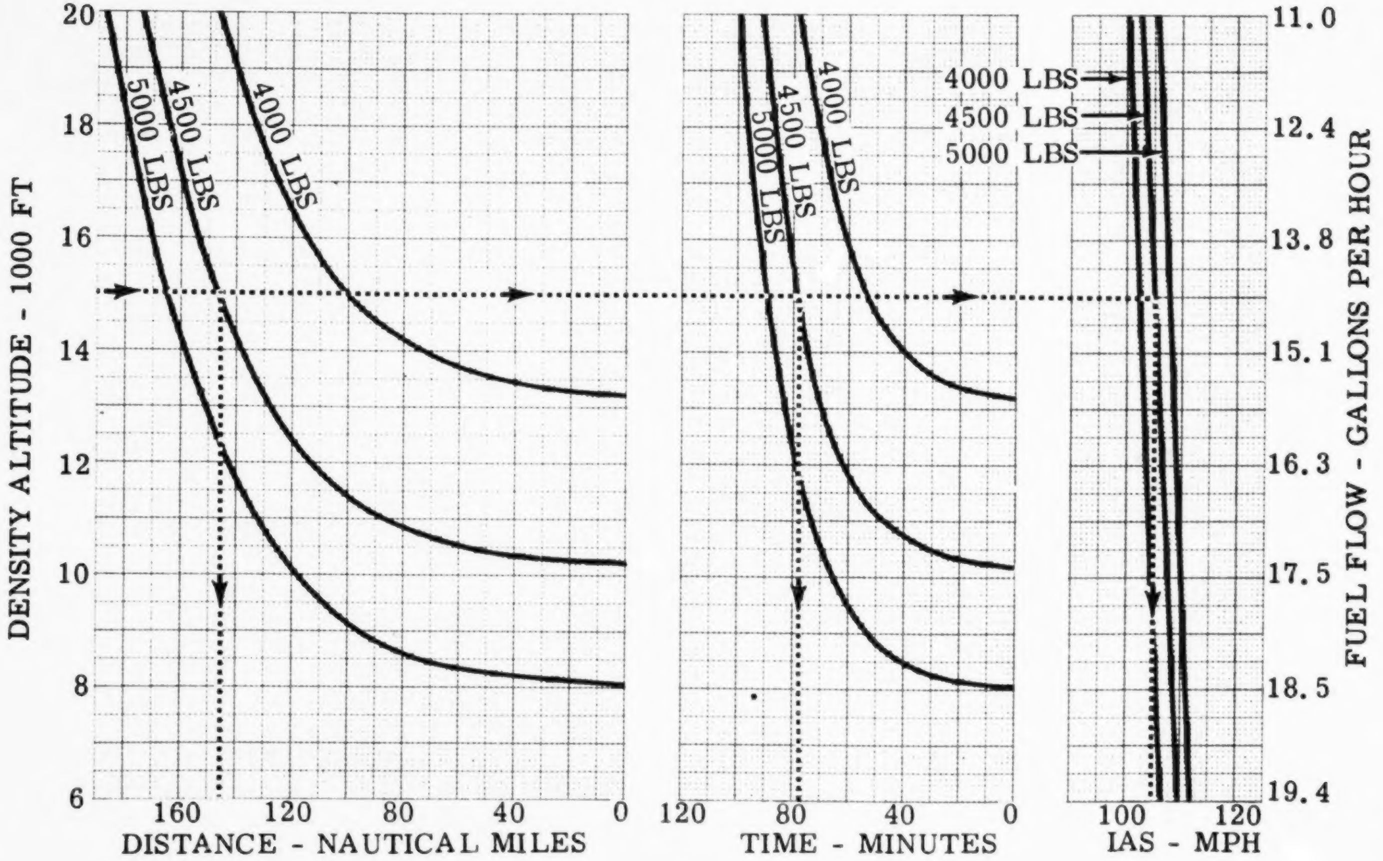

Figure A2-4-6

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Level Flight Performance A2-5-2

INTRODUCTION.

Refer to Section 1, Part 5 for explanation of level flight and cruise fuel consumption charts.

CRUISE FUEL CONSUMPTION.

Aircraft ▲ requires a mixture leaning technique that is unique with direct fuel injection engines (See Section VII). The correct fuel flow settings for cruising flight are shown on the cruise fuel consumption chart, figure A2-5-2.

CRUISE PERFORMANCE.

The normal cruise performance is shown in tabular form in figure A2-5-3. These charts provide power and fuel flow settings and resulting true airspeeds for a variety of cruise conditions. The range values shown in these charts do not include fuel allowances for takeoff, climb and reserve at destination.

LEVEL FLIGHT PERFORMANCE

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

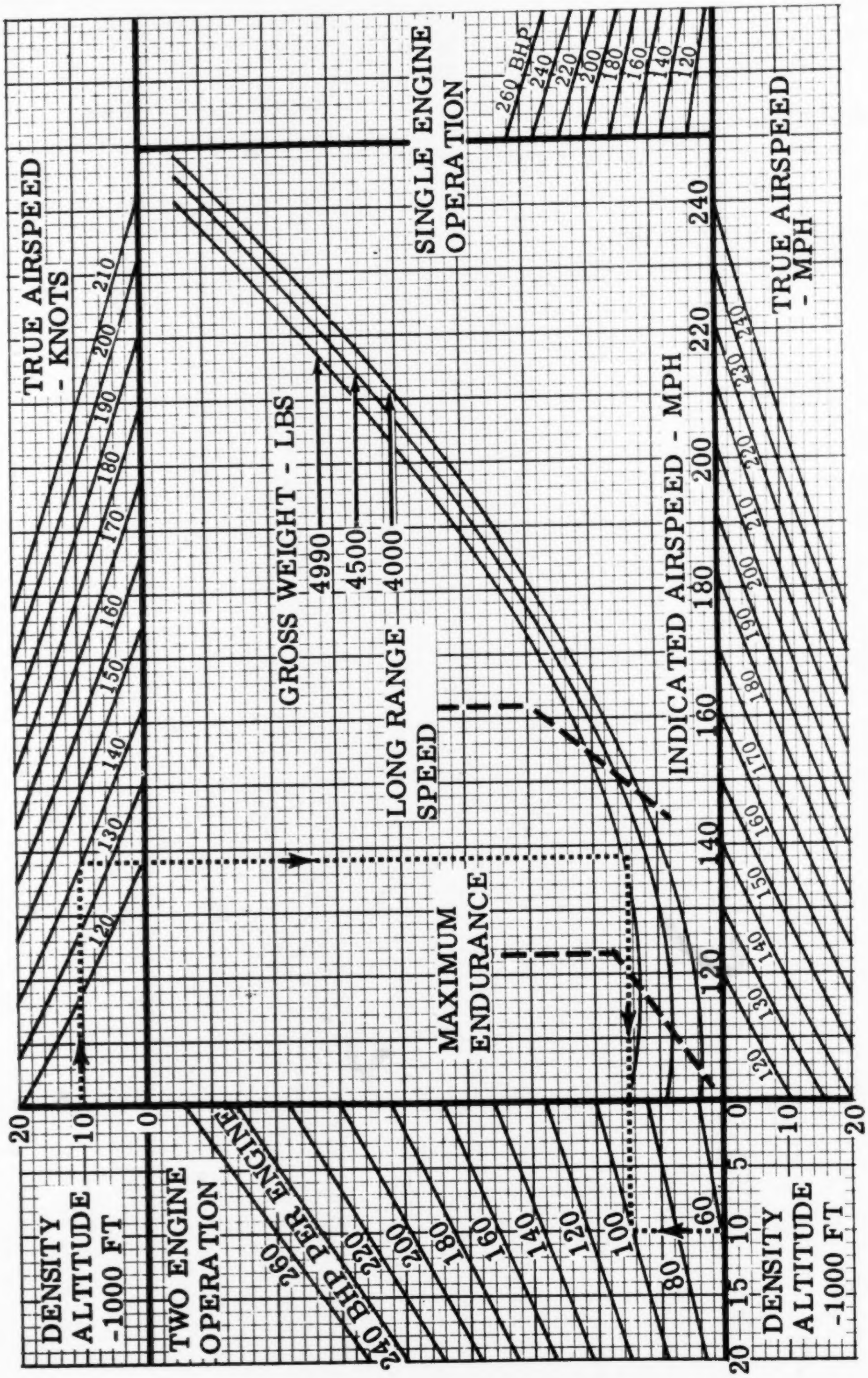

Figure A2-5-1

CRUISE FUEL CONSUMPTION

ALL ALTITUDES

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

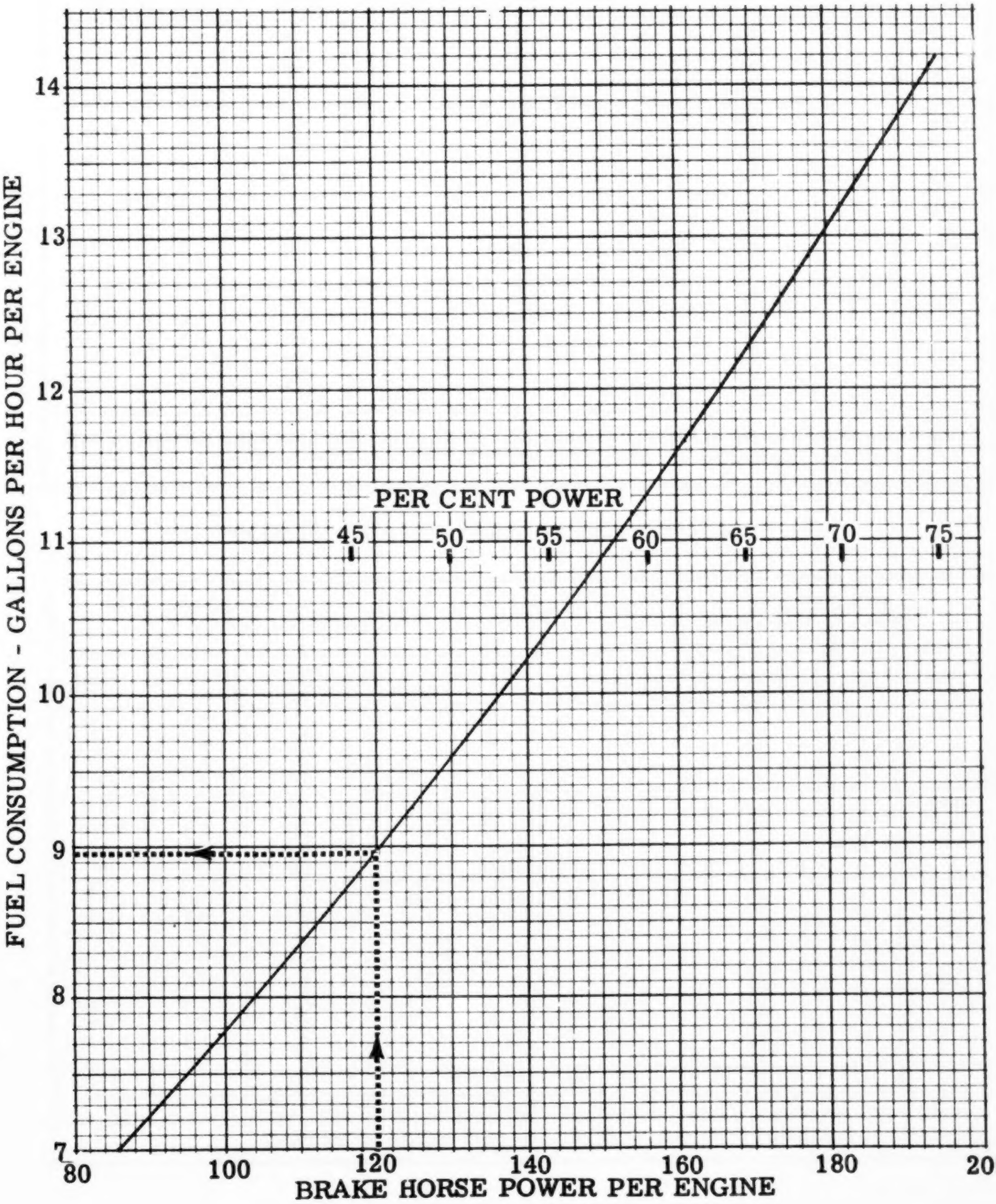

Figure A2-5-2

CRUISE PERFORMANCE WITH NORMAL LEAN MIXTURE AT 2,500 FT.

RPM	MP	% BHP	TAS	Total Gal/Hr.	Endurance 100 Gal.	Range 100 Gal.	Endurance 130 Gal.	Range 130 Gal
2450	24	74	185	28.1	3.6	661	4.6	857
	23	70	180	26.3	3.8	683	4.9	892
	22	66	176	24.9	4.0	705	5.2	918
	21	62	171	23.3	4.3	731	5.6	948
2300	24	68	177	25.5	3.9	696	5.1	909
	23	64	173	24.0	4.2	718	5.4	935
	22	60	169	22.8	4.4	739	5.7	961
	21	57	164	21.4	4.7	766	6.1	996
2200	23	59	167	22.3	4.5	748	5.8	974
	22	56	163	21.2	4.7	770	6.1	1000
	21	53	158	20.1	5.0	787	6.5	1022
	20	49	153	19.0	5.3	805	6.8	1048
2100	22	52	157	19.7	5.1	796	6.6	1035
	21	49	152	18.7	5.4	813	7.0	1057
	20	45	147	17.7	5.6	831	7.3	1079
	19	42	141	16.7	6.0	844	7.8	1096
	18	39	134	15.8	6.3	848	8.2	1105
	17	36	125	14.8	6.8	844	8.8	1096

CURISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, NORMAL LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL (NO RESERVE), AND 4990 POUNDS GROSS WEIGHT.

Note DISTANCES AND AIRSPEEDS ARE IN NAUTICAL MILES.

CRUISE PERFORMANCE WITH NORMAL LEAN MIXTURE AT 5,000 FT.

RPM	MP	% BHP	TAS	Total Gal/Hr.	Endurance 100 Gal.	Range 100 Gal.	Endurance 130 Gal	Range 130 Gal
2450	24	77	192	29.0	3.4	661	4.5	861
	23	72	186	27.2	3.7	679	4.8	883
	22	68	182	25.7	3.9	709	5.1	918
	21	64	177	24.1	4.2	731	5.4	953
2300	24	70	184	26.5	3.8	696	4.9	905
	23	66	178	24.7	4.0	722	5.3	940
	22	62	174	23.5	4.2	744	5.5	966
	21	58	169	22.1	4.5	766	5.9	996
2200	23	61	172	23.0	4.4	748	5.6	974
	22	58	168	21.8	4.6	770	6.0	1005
	21	54	164	20.6	4.8	796	6.3	1031
	20	51	158	19.5	5.1	813	6.7	1057
2100	22	53	162	20.3	4.9	800	6.4	1040
	21	50	157	19.2	5.2	822	6.8	1066
	20	47	152	18.3	5.5	831	7.1	1083
	19	44	146	17.2	5.8	848	7.6	1105
	18	41	140	16.3	6.1	861	8.0	1118
	17	37	131	15.3	6.5	861	8.5	1118

CURISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, NORMAL LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL (NO RESERVE), AND 4990 POUNDS GROSS WEIGHT.

Figure A2-5-3 (Sheet 1 of 3)

CRUISE PERFORMANCE WITH NORMAL LEAN MIXTURE AT 7,500 FT.

RPM	MP	%BHP	TAS	Total Gal/Hr.	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	22	70	188	26.6	3.8	705	4.9	918
	21	66	183	24.9	4.0	735	5.2	957
	20	62	178	23.5	4.3	757	5.5	987
	19	58	172	22.1	4.5	779	5.9	1014
2300	22	64	181	24.2	4.1	748	5.4	970
	21	60	175	22.6	4.4	774	5.8	1005
	20	57	171	21.5	4.6	796	6.0	1035
	19	54	166	20.3	4.9	818	6.4	1061
2200	22	59	174	22.4	4.5	774	5.8	1009
	21	56	169	21.1	4.7	800	6.2	1040
	20	53	164	20.0	5.0	822	6.5	1066
	19	50	160	19.0	5.3	840	6.8	1092
2100	21	52	163	19.7	5.1	827	6.6	1074
	20	49	157	18.7	5.4	844	7.0	1096
	19	45	152	17.7	5.6	857	7.3	1118
	18	42	145	16.8	6.0	866	7.7	1127
	17	39	137	15.8	6.3	866	8.2	1127
	16	36	123	14.9	6.7	822	8.7	1070

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, NORMAL LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL (NO RESERVE), AND 4990 POUNDS GROSS WEIGHT.

Note DISTANCES AND AIRSPEEDS ARE IN NAUTICAL MILES.

CRUISE PERFORMANCE WITH NORMAL LEAN MIXTURE AT 10,000 FT.

RPM	MP	% BHP	TAS	Total Gal/Hr.	Endurance 100 Gal.	Range 100 Gal.	Endurance 130 Gal.	Range 130 Gal.
2450	20	64	184	24.2	4.1	761	5.4	992
	19	60	179	22.8	4.4	787	5.7	1022
	18	56	172	21.2	4.7	813	6.1	1057
	17	52	166	19.7	5.1	844	6.6	1096
2300	20	59	177	22.1	4.5	800	5.9	1040
	19	55	171	20.9	4.8	818	6.2	1066
	18	51	166	19.7	5.1	844	6.6	1096
	17	47	158	18.3	5.5	861	7.1	1122
2200	20	54	171	20.6	4.8	827	6.3	1074
	19	51	164	19.5	5.1	844	6.7	1096
	18	48	158	18.4	5.4	861	7.1	1118
	17	44	152	17.3	5.8	879	7.5	1140
2100	20	50	164	19.2	5.2	853	6.8	1109
	19	47	157	18.2	5.5	866	7.1	1127
	18	44	151	17.2	5.8	879	7.6	1140
	17	40	143	16.2	6.2	879	8.0	1135
	16	37	128	15.3	6.5	835	8.5	1083

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, NORMAL LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL (NO RESERVE), AND 4990 POUNDS GROSS WEIGHT.

Figure A2-5-3 (Sheet 2 of 3)

CRUISE PERFORMANCE WITH NORMAL LEAN MIXTURE AT 15,000 FT.

RPM	MP	% BHP	TAS	Total Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	16	51	171	19.4	5.2	879	6.7	1144
	15	46	160	18.0	5.6	892	7.2	1157
	14	42	148	16.7	5.8	883	7.8	1148
2300	16	46	161	18.1	5.5	887	7.2	1153
	15	42	148	16.7	6.0	883	7.8	1148
2200	16	43	152	17.1	5.8	892	7.6	1157
	15	40	131	15.6	6.4	844	8.3	1096
2100	16	40	136	16.1	6.2	844	8.1	1096

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, NORMAL LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL (NO RESERVE), AND 4990 POUNDS GROSS WEIGHT.

Note DISTANCES AND AIRSPEEDS ARE IN NAUTICAL MILES.

CRUISE PERFORMANCE WITH NORMAL LEAN MIXTURE AT 20,000 FT.

RPM	MP	% BHP	TAS	Total Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	13.5	42	131	17.2	5.8	761	7.6	992

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, NORMAL LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL (NO RESERVE), AND 4990 POUNDS GORSS WEIGHT.

Figure A2-5-3 (Sheet 3 of 3)

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Landing Distance A2-6-2

INTRODUCTION.

Refer to Section 1, Part 6 for discussion and explanation of the charts.

LANDING DISTANCE

MODEL: U-3B
DATE: 15 NOV 1960
DATA BASES: FLIGHT TEST

ENGINES: (2) IO-470-D
FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

INDICATED AIRSPEED - MPH

WT	3500	4000	4500	4990
APPROACH	79	85	91	95
STALL	60	65	70	74
TOUCHDOWN SPEED	63	67	70	74

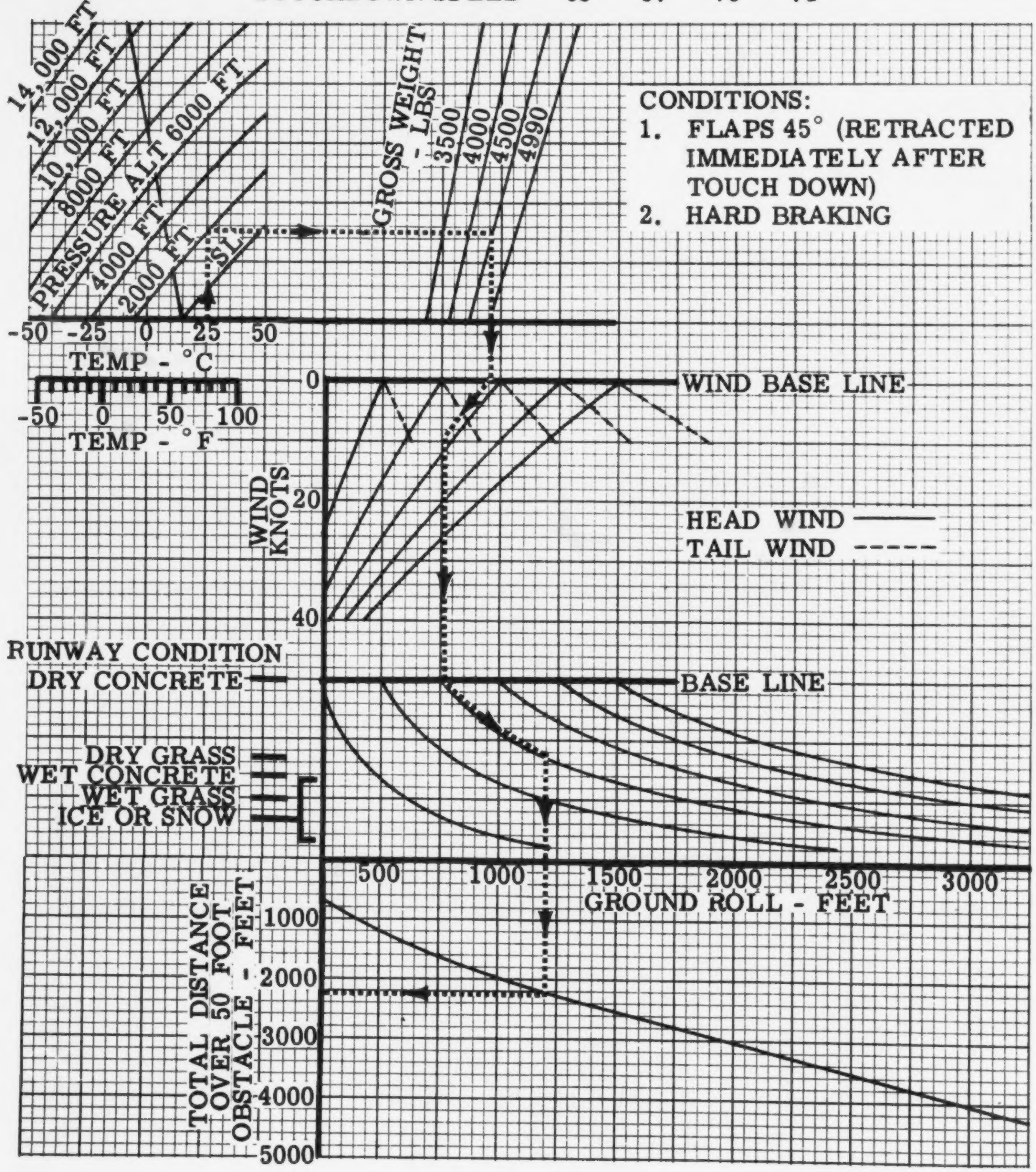

Figure A2-6-1

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INTRODUCTION.

Refer to Section 1, Part 7 for a complete sample mission. The procedure shown in Section 1, Part 7 is applicable to aircraft ▲ except charts having figure numbers starting with A2- must be used.

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PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
6	2-1 a			In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders
81		4-3		Callout 16 on figure 4-3 is pointing at a bolt. In the key to fig. 4-3, item 16 is called a shim. Please correct one or the other.
125	line 20			I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered so the NSN is wrong. Please give me a good NSN

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimenter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 38.82 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimenter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.365	metric tons	short tons	1.102
pound-inches	newton-meters	.11375			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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